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Crupina Integrated Weed Management Project

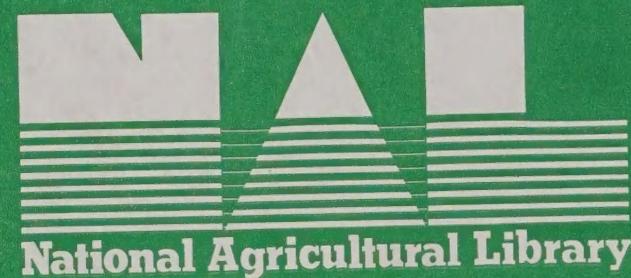
Final Environmental Impact Statement

Chelan Ranger District
Okanogan and Wenatchee National Forests
Chelan County, Washington

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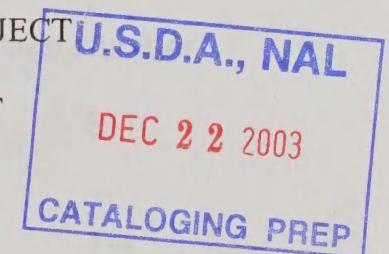
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OKANOGAN AND WENATCHEE NATIONAL FORESTS

CRUPINA INTEGRATED WEED MANAGEMENT PROJECT

FINAL ENVIRONMENTAL IMPACT STATEMENT

CHELAN COUNTY, WASHINGTON



Lead agency: U.S.D.A., Forest Service, Okanogan and Wenatchee National Forests

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Abstract: The Okanogan and Wenatchee National Forest Supervisor proposes integrated weed management activities in the middle Chelan watershed. The project includes a range of weed treatments, including chemical herbicides, to prevent the spread, contain, and work toward the eradication of crupina (*Crupina vulgaris*). The **No Action Alternative (A)** would not implement weed management activities to deal with the current crupina infestation.

Alternative B emphasizes continuation of the current hand-pulling method along with follow-up cultural treatments and addresses issues related to the use of herbicides. There would be no chemical or mechanical treatment methods used. Up to a maximum of 100-acres per year in areas infested with crupina would be hand-pulled. The **Proposed Action Alternative (C)** is the Agency preferred alternative. It would use several treatment methods to implement integrated weed management. Annually, Alternative C would implement up to a maximum 100-acres of herbicide treatment activities and up to 100-acres of treatment with a combination of hand-pulling and radiant heat disk. Follow-up cultural treatments would be included. This alternative would allow use of motorized equipment (pumps) and mechanical transport (helicopter) in wilderness. **Alternative D** was designed to address concerns raised by the use of motorized equipment, and mechanical transport in wilderness. It includes hand-pulling, herbicide, radiant heat disk, and follow-up cultural treatments. Annually, about 50-acres of herbicide treatment and about 100-acres of combined hand-pulling and heat disk treatments would be implemented.

Table of Contents

	Page Number
Summary	S-1
Chapter 1	
Section 1.1 – Project Overview	1-4
1.1.1 Setting and Scale	1-4
Section 1.2 Current Law and Management Direction and Guidance	1-5
1.2.1 Wenatchee National Forest Land and Resource Management Plan	1-5
1.2.2 The Northwest Forest Plan	1-7
1.2.3 Middle Chelan Watershed Assessment	1-9
1.2.4 Interior Columbia Basin Ecosystem Management Project (ICBEMP)	1-9
1.2.5 Guides to Noxious Weed Prevention Practices	1-10
Section 1.3 – Purpose and Need for the Proposed Action	1-11
Section 1.4 – Proposed Action	1-12
Section 1.5 – Responsible Agency and the Decision to be Made	1-17
Section 1.6 – Public Involvement	1-17
Section 1.7 – Issues	1-18
1.7.1 Key Issues	1-18
1.7.2 Other Measurements of Change	1-20
Chapter 2	
Section 2.1 – Alternative Description	2-1
2.1.1 The Alternatives	2-1
<u>Alternative A (No Action)</u>	2-1
<u>Alternative B (Only Hand-pulling Used)</u>	2-3
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	2-3
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Mechanized Support in Wilderness)</u>	2-4

Table of Contents

	Page Number
2.1.2 Features Common to Action Alternatives (B, C, D)	2-5
Weed Prevention Strategy	2-5
Cultural Treatments	2-6
Crupina Treatment Method Criteria	2-6
Crupina Treatment Priority Criteria	2-7
Crupina Treatment Timing	2-7
2.1.3 Mitigation Measures for Action Alternatives	2-7
Herbicide Treatments (Alternatives C and D only)	2-7
General	2-10
Vegetation	2-12
Wildlife	2-12
Heritage Resources	2-13
2.1.4 Other Alternatives Considered but Eliminated From Detailed Analysis	2-13
Section 2.2 Monitoring	2-14
Project Implementation Monitoring Table 2-2	2-15
Section 2.3 Alternative Comparison	2-16
Table 2-3	2-17
Section 2.4 The Forest Service Preferred Alternative	2-16
 Chapter 3	
Section 3.1 – The Biological Environment	3-1
3.1.1 Competing and Unwanted Vegetation: Affected Environment	3-1
3.1.2 Competing and Unwanted Vegetation:	
Environmental Consequences	3-3
<u>Alternative A (No Action)</u>	3-3
<u>Alternative B (Only Hand-pulling Used)</u>	3-4
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	3-5
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—<u>No Mechanized Support</u> in Wilderness)</u>	3-6

Table of Contents

	Page Number
Cumulative Effects for All Action Alternatives (B, C, or D)	3-6
3.1.3 Native Vegetation: Affected Environment	3-7
Disturbance history	3-7
3.1.4 Native Vegetation: Environmental Consequences	3-8
<u>Alternative A</u> (No Action)	3-8
<u>Alternative B</u> (Only Hand-pulling Used)	3-9
<u>Alternative C</u> (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)	3-10
<u>Alternative D</u> (Hand-pulling, Herbicides, and Radiant Heat Disks Used— <u>No Mechanized Support</u> in Wilderness)	3-11
Cumulative Effects for All Action Alternatives	3-11
3.1.5 Sensitive Plants: Affected Environment	3-11
3.1.6 Sensitive Plants: Environmental Consequences	3-12
<u>Alternative A</u> (No Action)	3-16
<u>Alternative B</u> (Only Hand-pulling Used)	3-16
<u>Alternative C</u> (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)	3-17
<u>Alternative D</u> (Hand-pulling, Herbicides, and Radiant Heat Disks Used— <u>No Mechanized Support</u> in Wilderness)	3-18
Cumulative Effects for All Action Alternatives	3-18
3.1.7 Survey and Manage Plants: Affected Environment	3-18
3.1.8 Survey and Manage Plants: Environmental Consequences	3-19
3.1.9 Wildlife and Habitat: Affected Environment	3-21
3.1.10 Wildlife and Habitat: Environmental Consequences	3-23
Effects Common to all Wildlife Species:	3-23
Cumulative Effects Common to all Wildlife Species:	3-24

Table of Contents

	Page Number
3.1.11 Threatened or Endangered Wildlife Species	3-26
TES WILDLIFE - Gray wolf	3-26
<u>Alternative A (No Action)</u>	3-26
<u>Alternative B (Only Hand-pulling Used)</u>	3-27
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	3-29
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—<u>No Mechanized Support in Wilderness</u>)</u>	3-32
TES WILDLIFE - Grizzly Bear	
<u>Alternative A (No Action)</u>	3-32
<u>Alternative B (Only Hand-pulling Used)</u>	3-33
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	3-34
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—<u>No Mechanized Support in Wilderness</u>)</u>	3-36
TES WILDLIFE - Northern Bald Eagle	
<u>Alternative A (No Action)</u>	3-37
<u>Alternative B (Only Hand-pulling Used)</u>	3-37
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	3-38
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—<u>No Mechanized Support in Wilderness</u>)</u>	3-39
3.1.12 Summary Effect Determinations for Wolf, Bear, Eagle	3-40
3.1.13 Sensitive Wildlife Species	3-40
3.1.14 Wildlife Management Indicator Species (MIS)	3-43
3.1.15 Northwest Forest Plan Wildlife Species	3-47
3.1.16 Landbirds	3-48

Table of Contents

	Page Number
3.1.17 Interior Columbia Basin Ecosystem Management Plan Wildlife Species	3-49
3.1.18 Other Wildlife Species of Concern with Special Status	3-49
3.1.19 Aquatic/Fishery Resources: Affected Environment	3-52
3.1.20 Aquatic/Fishery Resources: Environmental Consequences	3-57
<u>Alternative A (No Action)</u>	3-57
<u>Alternative B (Only Hand-pulling Used)</u>	3-57
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	3-58
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—<u>No Mechanized Support in Wilderness</u>)</u>	3-60
Section 3.2 – The Physical Environment	3-64
3.2.1 Soil Resources: Affected Environment	3-64
3.2.2 Soil Resources: Environmental Consequences	3-65
<u>Alternative A (No Action)</u>	3-65
<u>Alternative B (Only Hand-pulling Used)</u>	3-66
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	3-69
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—<u>No Mechanized Support in Wilderness</u>)</u>	3-72
3.2.3 Water Resources: Affected Environment	3-73
3.2.4 Water Resources: Environmental Consequences	3-76
<u>Alternative A (No Action)</u>	3-76
<u>Alternative B (Only Hand-pulling Used)</u>	3-77
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	3-79
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—<u>No Mechanized Support in Wilderness</u>)</u>	3-83

Table of Contents

	Page Number
Section 3.3 – The Human Environment	3-86
3.3.1 Human Health and Safety: Affected Environment	3-86
3.3.2 Human Health and Safety: Environmental Consequences	3-86
<u>Alternative A (No Action)</u>	3-86
<u>Alternative B (Only Hand-pulling Used)</u>	3-87
General Effect Information Common for the Use of Herbicides in <u>Alternatives C and D</u>	3-87
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	3-97
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—<u>No Mechanized Support in Wilderness</u>)</u>	3-99
3.3.3 Recreation: Affected Environment	3-100
3.3.4 Recreation Facilities: Environmental Consequences	3-102
<u>Alternative A (No Action)</u>	3-102
<u>Alternative B (Only Hand-pulling Used)</u>	3-102
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	3-103
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—<u>No Mechanized Support in Wilderness</u>)</u>	3-104
Recreation Visitor Use: Environmental Consequences	3-105
<u>Alternative A (No Action)</u>	3-105
<u>Alternative B (Only Hand-pulling Used)</u>	3-105
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	3-106
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—<u>No Mechanized Support in Wilderness</u>)</u>	3-107

Table of Contents

	Page Number
3.3.5 Wilderness: Affected Environment	3-108
3.3.6 Wilderness: Environmental Consequences	3-109
<u>Alternative A (No Action)</u>	3-109
<u>Alternative B (Only Hand-pulling Used)</u>	3-110
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	3-111
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—<u>No Mechanized Support in Wilderness</u>)</u>	3-113
3.3.7 Unroaded Character	3-116
3.3.8 Scenery: Affected Environment	3-116
3.3.9 Scenery: Environmental Consequences	3-116
<u>Alternative A (No Action)</u>	3-116
<u>Alternative B (Only Hand-pulling Used)</u>	3-116
<u>Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)</u>	3-117
<u>Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—<u>No Mechanized Support in Wilderness</u>)</u>	3-117
3.3.10 Heritage Resources: Affected Environment	3-118
3.3.11 Heritage Resources: Environmental Consequences	3-120
<u>Alternative A (No Action)</u>	3-120
<u>Action Alternatives</u>	3-120
3.3.12 Other Social Effects	3-122
3.3.13 Economics	3-123
Section 3.4 – Disclosures	3-124
3.4.1 Adverse Effects That Cannot be Avoided	3-124
3.4.2 Short-term Use Versus Long-term Productivity	3-124

Table of Contents

	Page Number
3.4.3 Effects on Energy and Conservation and Irreversible or Irrecoverable Effects	3-125
3.4.4 Possible Conflicts Between the Proposed Action and the Objectives of Federal, Regional, State, and Local Land Use Plans, Policies, and Controls	3-125
 Chapter 4	
Section 4.1 List of Preparers	4-1
Section 4.2 Agencies, Organizations, and Persons to Whom Copies of the DEIS were Provided	4-2

List of Tables, Figures, and Appendices

<u>Tables</u>	Page Number
Table 1-1. Project Area Forest Plan Land Allocations and Private Land Acreage.	1-4
Table 1-2. Suitable Crupina Habitat Characteristics.	1-8
Table 2-1. Criteria for Seeding/Re-vegetation.	2-6
Table 2-2. Monitoring Plan for Action Alternatives.	2-15
Table 2-3. Comparison of Alternatives.	2-17
Table 3-1. TES plants known to occur, or have the potential to occur, in the project area.	3-13
Table 3-2. Survey and Manage species that could occur on the Wenatchee portion of the Okanogan and Wenatchee National Forests.	3-20
Table 3-3. Summary Effect Determinations for Gray Wolf, Grizzly Bear, and Bald Eagle	3-40
Table 3-4. Project Area Wildlife Management Indicator Species.	Appendix H
Table 3-5. Project Area Stream Attributes.	3-52
Table 3-6. Checklist for documenting environmental baseline for Aquatic/Riparian conditions in the Project Area.	3-56
Table 3-7. Checklist for documenting the effects of the preferred alternative on aquatic/riparian conditions in the Deer Point Fire Area.	3-61
Table 3-8. Rates of Accelerated Soil Erosion.	Appendix E
Table 3-9. Potential Crupina Treatment Areas within 50-Feet of Water by Watershed.	3-75

<u>Tables</u>	<u>Page Number</u>
Table 3-10. Estimated Distance of Picloram Movement by Slope Gradient.	3-87
Table 3-11. Comparison of Herbicide Toxicity.	3-90
Table 3-12. Estimated capacity of the lake for boats	3-101
Table 3-13. Acres by Wilderness Recreation Opportunity Spectrum Class	3-109
Table 3-14. Annual Energy Consumption.	3-125

Figures

Figure S-1. Vicinity Map	S-2
Figure S-2. Proposed Action Map	S-3
Figure 1-1. Vicinity Map	1-2
Figure 1-2. Project Area Map showing the Lake Chelan-Sawtooth Wilderness Area and the Rex Creek Wildfire area	1-3
Figure 1-3. Proposed Action Map	1-5
Figure 1-3. Wenatchee National Forest Land Allocations Map	1-6
Figure 1-4. Northwest Forest Plan Land Allocations	1-8
Figure 2-1. Alternative Map	2-2
Figure 3-1. Analysis Area Watersheds	3-74

List of Appendices

Appendix A	References
Appendix B	Spill Plan
Appendix C	Washington State Noxious Weed Definitions
Appendix D	Chelan Ranger District Potential TES Plants
Appendix E (Table 3-8.)	Rates of Accelerated Soil Erosion
Appendix F	Excerpts from the 1964 Wilderness Act
Appendix G	Wilderness Recreation Opportunity Class (WROS) Descriptions
Appendix H (Table 3-4.)	Wildlife Management Indicator Species Potentially Present in the Project Area.
Appendix I	Mediated Agreement Requirements
Appendix J	Agency Letters and Response to Comments on the DEIS
Appendix K	Response to Public Comments on the DEIS

Summary

Summary changes between the Draft and Final Environmental Impact Statements:

A project vicinity map has been added as well as a map showing the full extent of the Lake Chelan-Sawtooth Wilderness Area and Rex Creek wildfire area (Figures S-1 and S-2).

All other changes were minor.

Summary

The Okanogan and Wenatchee National Forest Supervisor proposes integrated weed management activities in the middle Chelan watershed area northwest of Chelan, Washington. The project includes a range of weed treatments, including chemical herbicides, to prevent the spread, contain, and work toward the eradication of *Crupina vulgaris* var. *brachypappa* (crupina), a non-native, Class A noxious weed. Recent wildfires have increased susceptibility and risk to invasion by crupina in the Lake Chelan-Sawtooth Wilderness Area and adjacent lands. Treatment proposals include the use of herbicides, motorized equipment (pumps), and mechanical transport (helicopters) in the Lake Chelan-Sawtooth Wilderness Area.

The Current Situation

The known infestation of crupina is on about 500-acres north of Lake Chelan, in patches between Prince Creek and Hunts Bluff: T31N, R18E, sections 2, 3, 12, 13; T31N, R19E, sections 18, 19, 29, 30; T32N, R18E, section 28, 33, 34 (see maps, pages S-2 and S-3). Of the total, about 210-acres are on private land, about 255-acres are within the Lake Chelan-Sawtooth Wilderness Area on National Forest System land, and about 15-acres are on National Forest System land outside wilderness.

The current infestation and proposed treatment areas are along the north shore of Lake Chelan and include about 500-acres, with an additional 4,500-acres of potential habitat. About half the area currently infested is located on National Forest System land. This is the only known population of crupina in Washington State. Recent wildfires along the north shore of Lake Chelan and areas further down-lake toward the town of Chelan have created a ten-fold increase in acreage of shrub/steppe habitat that is susceptible to invasion by crupina. The Rex Creek fire in 2001 burned a total of about 55,000-acres. There is a concern that crupina could spread outside the current infestation boundary with potential to invade susceptible habitat over a much larger area.

Since introduction to North America about 30-years ago, crupina has spread to over 60,000 acres in Idaho, with smaller populations in Oregon, Washington, and California. In cooperation with the Washington State Department of Agriculture, the Animal and Plant Health Inspection Service (APHIS), the University of Idaho, various weed boards, private landowners, and the Forest Service, a substantial amount of funds have been expended to date to treat the Lake Chelan infestation of crupina. While efforts to limit the spread of crupina to areas other than the

Vicinity Map

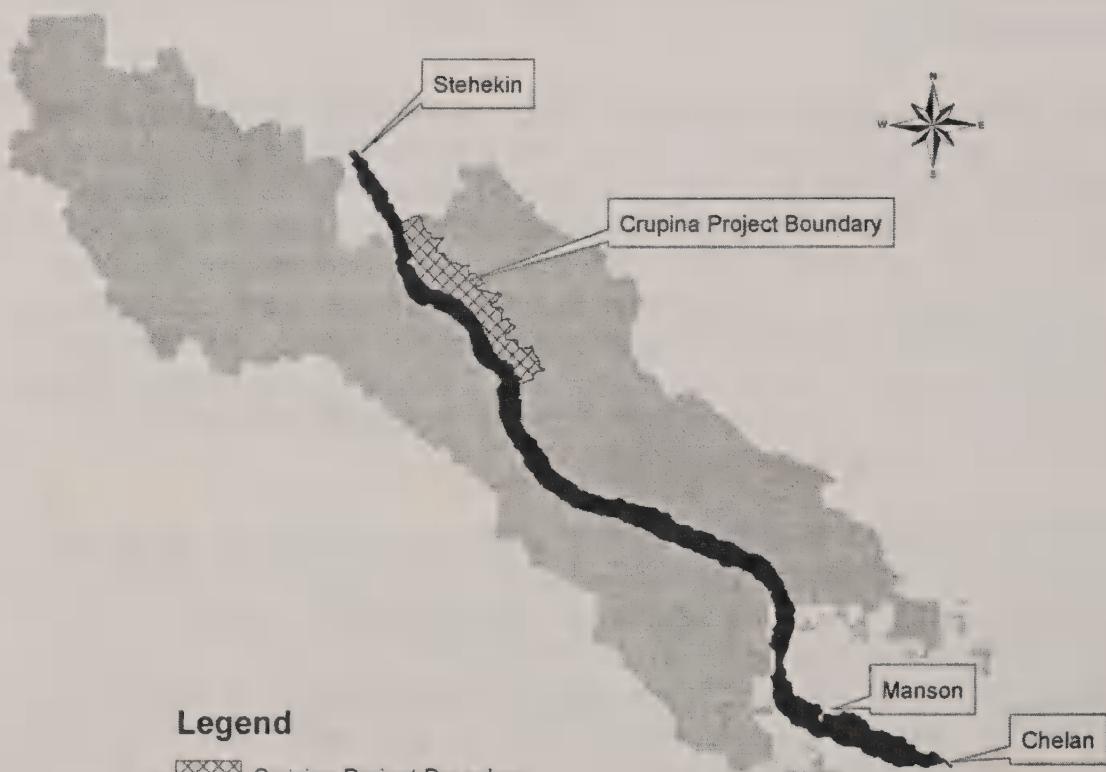
S-1



Project Location

Chelan Ranger District

Okanogan-Wenatchee National Forest



Legend

Crupina Project Boundary

Chelan Ranger District

Lakes

**Crupina Project Location Map
Proposed Action Figure S-2**



Fish Creek

Round Mtn.

Moore Point

Lucerne

Domke Lake

Surprise Lake

Prince Creek

Lake Chelan

Prince Cr. Campground



Project Boundary

Crupina Historical Locations

Potential Crupina Habitat

Local Trail System

Streams

S-3

Scale = 1:77,559

1 inch equals 1.22 miles

0 0.5 1 2 Miles

north shore of Lake Chelan have worked, attempts to eradicate crupina have not been successful. For a number of reasons, hand-pulling has been the only treatment method used on National Forest System land. While hand-pulling, hoeing, or other tillage is the best treatment in and adjacent to homesites, sensitive areas, or where infestations consist of a few plants that can be inspected frequently, limited access and the rugged terrain at Lake Chelan are jeopardizing previous weed treatment efforts. Other factors that warrant consideration include available funding to address the spread of noxious weeds and the large increase in potential habitat available for invasion by crupina due to recent fires. On wilderness land, crupina is reducing native ecosystem biodiversity and compromising the wilderness resource, other resource values, and ecosystem integrity.

Purpose and Need

The purpose of the Crupina Integrated Weed Management Project is to contain, control, and move toward the eradication of crupina in the current area of infestation near Lake Chelan. Action is needed:

- to protect the biodiversity of the middle Chelan watershed by limiting the spread, controlling, and eventually eradicating crupina, a non-native, Class A noxious weed;
- to protect or restore ecosystem integrity, specifically native vegetation and unique habitats including wetlands and sensitive plant populations;
- to protect wilderness values and resources;
- to prevent potential spread of crupina to other land up- and down-lake from the current infestation and on to about 4,500-acres of suitable habitat created by the 2001 Rex Creek wildfire;
- to prevent the potential spread of crupina to other land outside the analysis area;
- to limit the spread, control, and eventually eradicate known populations of crupina on trails, campsites, and wildlife forage habitat;
- to improve the effectiveness of current treatment methods;
- to control the invasion of perennial weeds and cheatgrass after treatment of crupina.
- to cooperate with landowners to treat crupina on private land adjacent to National Forest System land (requires consent from landowners).

Public Involvement

Initial public involvement regarding the Lake Chelan crupina infestation began in 1990 and 1991 with scoping for an environmental assessment. A decision was made to hand-pull crupina. In 2001, following the Rex Creek wildfire, a public meeting was held to discuss potential rehabilitation treatments in the burned area. One of the topics at this meeting was the need for additional treatment of crupina in light of the vast area without vegetation. A scoping letter for the current proposed action was mailed in June 2002, accompanied by newspaper

and radio notices. In October 2002 a letter was sent to private landowners within the boundary of the project area to ask for interest in participating to control crupina. A second letter to private landowners scheduled a meeting to discuss potential crupina treatments.

A notice of intent (NOI) to prepare an environmental impact statement for the project was first published in volume 67, number 201 of the Federal Register, on Thursday, October 17, 2002. A revised NOI with a project name change was published in volume 68, number 72, of the Federal Register on April 15, 2003. A second revised NOI to change the responsible official was published August 5, 2003 in volume 68, number 150 of the Federal Register.

Comments were received from several individuals, agencies, businesses, and organizations before the DEIS was published. Public comments were received in the form of letters, electronic mail messages, phone calls, and personal visits.

A Draft Environmental Impact Statement (DEIS) was prepared in August 2003 with notice published in volume 66, number 172, of the Federal Register on September 5, 2003. Comments on the DEIS were due by October 20, 2003. Two comment letters were received from public agencies (see **Appendix J**). A response to public comments received on the DEIS is included in **Appendix K**.

Issues

The interdisciplinary team used the comments received during scoping to identify potential conflicts and develop issues. A list of issues was developed and after review, some issues were withdrawn from analysis because broader effects analysis addressed them adequately; because they were outside the scope of the project; or because prescribed mitigation measures resolved potential conflicts.

KEY ISSUE 1: POTENTIAL EFFECTS OF HERBICIDES ON HUMAN HEALTH, PLANTS, WILDLIFE, FISH, WATER QUALITY, AND SOIL.

There is a concern that use of herbicides to control weed infestations would have potential impacts on human health. Potential effects on human health from herbicide use are addressed and considered by the EPA, as well as the Forest Service. A list of references that includes assessing risk to human health is contained in **Appendix A**.

Issue Indicators:

- Potential for herbicide exposure; measured by toxicity levels in terms of safe reference doses (RfDs).
- Herbicide application in accordance with Forest Service Manual 2150 (Pesticide-Use Management and Coordination; measured in acres of herbicide treatment.

- Herbicide application in accordance with Forest Service Handbook 2109.14 (Pesticide-Use Management and Coordination Handbook); measured in acres of herbicide treatment.
- All crupina treatments consistent with the Okanogan and Wenatchee National Forests Hazard Communication Program and Forest Service Handbook 6709.11 (Health and Safety Code Handbook); measured in acres of herbicide treatment.

There is also concern about effects of herbicides used for crupina control on water quality and other biological resources on National Forest System land. Concerns include the direct, indirect, or cumulative effects from the use of herbicides on project area water quality, soil, and the habitat for plant, wildlife, and aquatic species.

Issue Indicators:

- Impacts that exceed regulatory compliance thresholds and potential impacts of herbicides to non-target resources; measured in acres of herbicide treatment.
- Shrub steppe habitat threatened by crupina infestations (mule deer winter and spring range, grizzly bear spring emergence habitat, bald eagle winter/spring foraging habitat); measured in terms of a trend to native vegetation recovery based on crupina treatment acreage.
- Temporary disturbance to security/core habitat from crews; measured by crupina treatment acreage.
- Temporary disturbance to security/core habitat from motorized equipment; measured by crupina treatment acres with support from motorized equipment.

KEY ISSUE 2: POTENTIAL EFFECTS OF PROPOSED WEED TREATMENTS ON WILDERNESS VALUES

The use of motorized equipment and mechanical transport (pumps and helicopters) in the wilderness can affect wilderness values. Noise can disturb both wildlife and recreationists, affecting the quality of wilderness experience. Public concern was also expressed regarding use of herbicides in wilderness. Some feel the proposed treatments are inconsistent with the 1964 Wilderness Act (P.L. 88-577). Although legislatively protected, all wilderness areas have been impacted to some degree by human disturbances. Among these disturbances is the introduction of invasive exotic plants. Managers are charged with the responsibility of maintaining the enduring resource of wilderness. The Wilderness Act mandates that "wilderness be managed so its community of life is untrammeled by man, its primeval character is retained, and its natural conditions are preserved" and to "assure that an increasing population, accompanied by an expanded settlement and growing mechanization, does not occupy and modify all areas within the United States." Forest Service direction is to maintain wilderness in such a manner that ecosystems are unaffected by human

manipulation and influences so that plants and animals develop and respond to natural forces (FSM 2320.2).

Issue Indicator:

- Effects on wilderness integrity (values and experiences); measured by crupina treatment acres and trend to recovery of native vegetation.

Other Measurements of Change

In addition to resources associated with the Key Issues, the effects the alternatives have on a variety of other resources are disclosed. These resources are managed under Forest Plan Standards and Guidelines. The effects the alternatives have on these resources are described in Chapter 3 of this EIS.

They include:

- Vegetation (native vegetation, sensitive plants, competing and unwanted vegetation)
- Terrestrial wildlife species and habitats (threatened, endangered, and sensitive designations; management indicator species)
- Fish species and aquatic habitat
- Wilderness
- Recreation facilities and visitor use
- Heritage resources
- Scenery
- Roadless character

Alternatives

The **No Action Alternative (A)** would not implement weed management activities. No efforts would be taken to deal with the current crupina infestation.

Alternative B emphasizes continuation of the current hand-pulling method along with follow-up cultural treatments and addresses issues related to the use of herbicides. Up to a maximum of 100-acres per year in areas infested with crupina would be hand-pulled. The 100-acre figure is based on recent experience with hand-pulling treatments. There would be no chemical or mechanical methods used, though wilderness land would be treated. The

Proposed Action Alternative (C) is the Agency preferred alternative. It would use several treatment methods to implement integrated weed management.

Annually, Alternative C would implement a maximum of 100-acres of herbicide treatment activities and up to 100-acres of combined hand-pulling and use of radiant heat disks. Follow-up cultural treatments would be included. This alternative would allow use of motorized equipment (pumps) and mechanical transport (helicopter) in wilderness. This alternative is designed to limit the loss of plant diversity, the disruption of ecosystem function, and invasion by secondary weeds that may be more difficult to control. **Alternative D** was designed to address concerns raised by the use of herbicides, motorized

equipment, and mechanical transport in wilderness. It includes hand-pulling, herbicide, radiant heat disk, and follow-up cultural treatments. The use of motorized equipment and mechanical transport in wilderness would be prohibited. Limited herbicide treatment would be allowed with restrictions due to safety and operational considerations. Annually, about 50-acres of herbicide treatments and 100-acres of combined hand-pulling and mechanical methods would be implemented.

Alternative Comparison

This section provides a cursory comparison of the alternatives, and a synopsis of issue related environmental consequences for the key issues. The intent is to highlight the differences between the alternatives and between the effects the alternatives have on the issues. For more detail, see specific resource discussions in Chapter 3. **Table 2-3** (pages S-9 and S-10, also located in Chapter 2, pages 2-17 and 2-18) presents a snapshot of the key features of all alternatives.

Decisions to be Made

The Okanogan and Wenatchee Forest Supervisor has been delegated the authority as the deciding official for this project. The decision options include:

- Whether or not to implement weed treatment activities. If so, identify the site-specific locations of appropriate treatments.
- Whether or not to use herbicides, or motorized equipment (pumps) and mechanical transport (helicopters) in wilderness.
- If weed treatments are chosen, what mitigation and monitoring is needed to protect resources.

Table 2-3. Comparison of Alternatives.

Issues	Alternatives			
	A	B	C	D No Motorized Equipment or Mechanized Transport in Wilderness
Acres of annual weed treatment by method	None	Hand-pull only	Proposed Action	
Hand-pull		100-acre max	100-acre max hand-pull and heat disk;	100-acre max hand-pull and heat disk
Radiant heat disk		none	100-acre max	50-acre max
Herbicide		none		
Total annual weed treatments (all methods)	None	100	200	150
Annual wilderness weed treatment acres	None	Up to 100	Up to 200	10
Implementation of integrated weed management?	No	No	Yes	Yes
Restore native vegetation and biodiversity (ecosystem integrity)	No	Limited	More likely due to more treated acres than B or D	Limited, though more acres than B
Likely to limit the spread of crupina, leading to control and eventual eradication?	No	To date, spread limited but no control or eradication	Yes, most likely to control or eradicate	Yes, spread limited, fewer acres than B
Potential effects on resources from herbicides	No	No herbicides used	Yes, but mitigation measures applied	Yes, fewer acres than C
Potential effects on human health from herbicides	No	No herbicides used	Yes, minimal and below reference dose levels of toxicity	Yes, minimal with less acreage than C; toxicity levels below reference doses
Potential to exceed herbicide RfDs (reference doses)	No	No	No	No
Includes use of motorized equipment (pumps) and mechanical transport (helicopters) in wilderness	No	No	Yes, mitigation would limit use	No

Issues	Alternatives			
	A No Action	B Hand-pull only	C Proposed Action	D No Motorized Equipment or Mechanized Transport in Wilderness
Wilderness integrity compromised	Yes, no trend to restore	Yes, current condition maintained	Yes, with trend to restore	Yes, trend to restore on fewer acres than B
Weed treatment consistent with wilderness standards and guidelines	Yes	Yes	Yes	Yes
Potential private land weed treatments	No	Yes	Yes	Yes
Weed treatment workers (total worker-days)	None	40 (1,920)	50 (2,240)	50 (2,080)
Potential disturbance to wildlife security/core habitat from motorized equipment and weed treatment workers	No	Yes	Yes	Yes
Effects of crupina treatments on shrub steppe habitat (mule deer winter and spring range, grizzly bear spring emergence habitat, bald eagle winter/spring foraging habitat)	None	Yes, short-term restoration, long-term current conditions maintained	Yes, more likely with more acres than B or D, with trend to long-term restoration	Yes, trend to long-term restoration on fewer acres than B
Herbicide application in accordance with Forest Service Manual 2150 (Pesticide-Use Management and Coordination)	N/A	N/A	Yes	Yes
Herbicide application in accordance with Forest Service Handbook 2109.14 (Pesticide-Use Management and Coordination Handbook)	N/A	N/A	Yes	Yes
All crupina treatments consistent with the Okanogan and Wenatchee National Forests Hazard Communication Program and Forest Service Handbook 6709.11 (Health and Safety Code Handbook)	N/A	Yes	Yes	Yes

Chapter 1

Purpose and Need

Chapter 1 changes between the Draft and Final Environmental Impact Statements:

A project vicinity map has been added as well as a map showing the full extent of the Lake Chelan-Sawtooth Wilderness Area and Rex Creek wildfire area (Figures 1-1 and 1-2).

In the section on Proposed Action, suitable crupina habitat has been clarified, as well as the life history of crupina and the potential vectors for spread.

All other changes were minor.

Chapter

1

Purpose of and Need for Action

This analysis documents a proposal to develop and implement an integrated weed management strategy to contain and control crupina (*Crupina vulgaris* var. *brachypappa*), a noxious weed. The long-term goal is to eradicate crupina. Integrated weed management is defined in the Forest Service Manual as an interdisciplinary pest management approach for selecting methods for preventing, containing, and controlling noxious weeds in coordination with other resource management activities to achieve optimum management goals and objectives. Methods include: education, preventive measures, chemical, cultural, physical or mechanical methods, biological control agents, and general land management practices, such as manipulation of livestock or wildlife grazing strategies that accomplish weed management objectives. The proposal would allow for treatment of new crupina infestations if spreading occurs.

The current infestation and proposed treatment areas are along the north shore of Lake Chelan and include about 500-acres, with an additional 4,500-acres of potential habitat (see vicinity map **Figure 1-1**, page 1-2). About half the area currently infested is located on National Forest System land. This is the only known population of crupina in Washington State. Recent wildfires along the north shore of Lake Chelan and areas further down-lake toward the town of Chelan have created a ten-fold increase in acreage of shrub/steppe habitat that is susceptible to invasion by crupina. The Rex Creek wildfire in 2001 burned a total of about 55,000-acres (see **Figure 1-2**, page 1-3). There is a concern that crupina could spread outside the current infestation boundary with potential to invade susceptible habitat over a much larger area.

A weed is a plant growing where it is not desired, or any plant that is a nuisance, a hazard, or causes injury to humans, animals, or desired plants. Noxious weeds are defined by law as non-native, undesirable, or difficult to control. Federal, State, or County officials can designate noxious weeds. Crupina is a Class A noxious weed on the Washington State noxious weed list. Regulations require action by the landowner to prevent further spread, control, and eradicate Class A noxious weeds. Since introduction to North America about 30-years ago, crupina has spread to over 60,000 acres in Idaho, with smaller populations in Oregon, Washington, and California. Further information is available from the web site for the State Weed Board at <http://www.wa.gov/agr/weedboard>. In cooperation with the Washington State Department of Agriculture, the Animal and Plant Health Inspection Service (APHIS), the University of Idaho, various weed boards, private landowners, and the Forest Service, a substantial amount of funds have been expended to date to treat the Lake Chelan infestation of crupina.

Vicinity Map

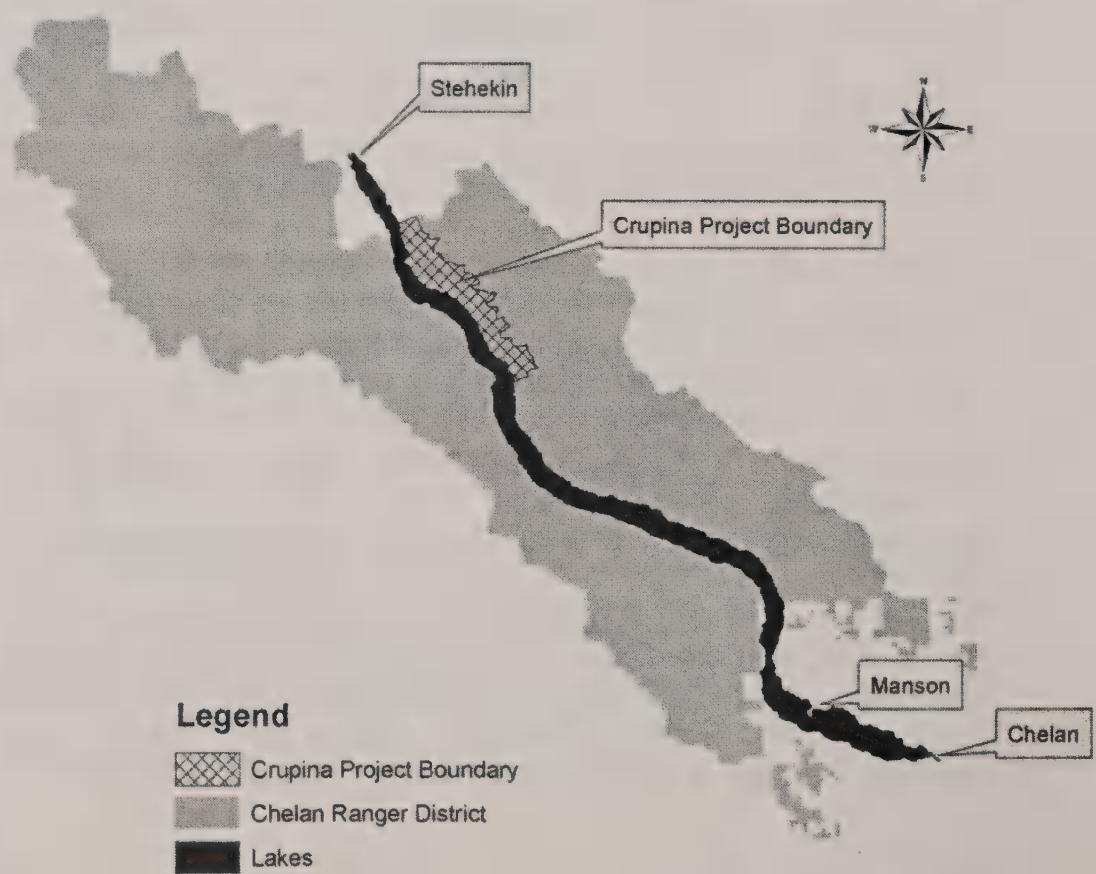
Figure 1-1



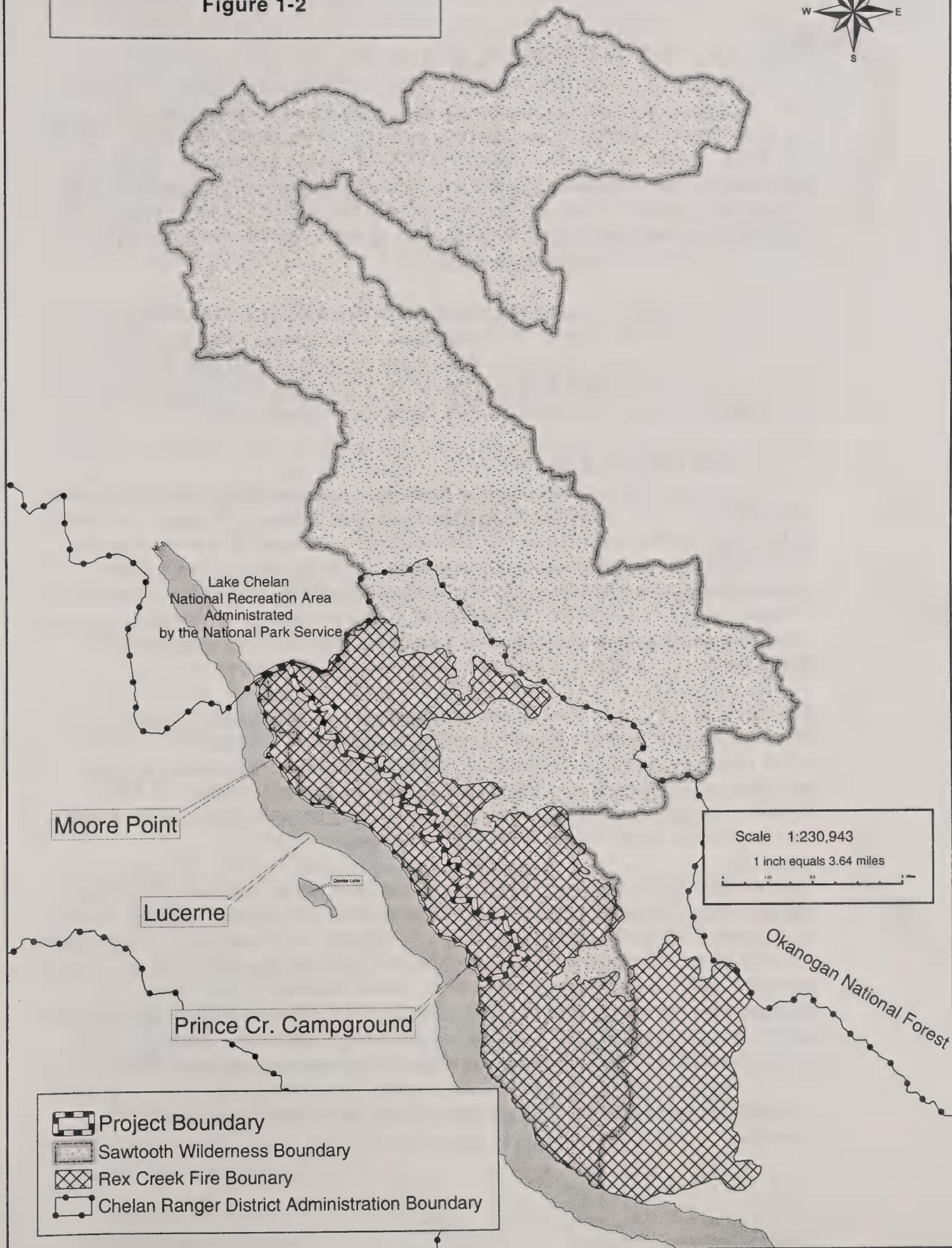
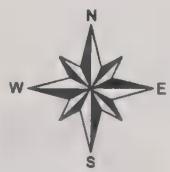
Project Location

Chelan Ranger District

Okanogan-Wenatchee National Forest



Crupina Project Area Map
Figure 1-2



Section 1.1 – Project Overview

The known infestation of crupina is on about 500-acres north of Lake Chelan, in patches between Prince Creek and Hunts Bluff: T31N, R18E, sections 2, 3, 12, 13; T31N, R19E, sections 18, 19, 29, 30; T32N, R18E, section 28, 33, 34 (see project area map, **Figure 1-2**, page 1-3). Of the total, about 210-acres are on private land, about 255-acres are within the Lake Chelan-Sawtooth Wilderness Area on National Forest System lands, and about 15-acres are on National Forest System land outside wilderness.

Crupina has the ability to survive harsh environments; it is a winter annual that reproduces by seed. Due to this adaptation, and because there is a lack of natural control agents to keep it in check, crupina can spread rapidly to new areas. Crupina becomes dominant particularly following disturbance events and has the potential to completely replace native plant communities.

1.1.1 Setting and Scale

The 3.9 million acre Okanogan and Wenatchee National Forests (OWNF) extend along the east side of the Cascade Mountains in Washington State. The OWNF is bounded on the north by the Pasayten Wilderness Area; on the west by the Cascade crest; and on the south by the Goat Rock Wilderness Area. The Chelan Ranger District administers an area of about 400,000-acres. The Lake Chelan area is mostly rural, with orchards, forestry, livestock grazing, mining, and agriculture as principal uses. Communities are small, with summer residences along the lake. Outdoor recreation in all seasons is increasing.

The analysis area is located on the north side of the middle Chelan watershed, 30-miles northwest of the town of Chelan, Washington. It occupies a relatively small percentage (0.5%) of the middle Chelan watershed and contains three west-flowing streams (Fish, Prince, and Canoe Creeks) that drain into Lake Chelan. Twenty-six miles down-lake from the project area, Lake Chelan flows into the Chelan River before reaching the Columbia River.

The project area is just over 10,000-acres in size, including about 745-acres of private land. The patches of crupina range in size from several hundred square feet to about 55-acres, though some locations have single scattered plants. The majority of the infestation occurs from around 1,500-feet to 2,500-feet in elevation with Lake Chelan at 1,100-feet. Upper elevation areas infested with crupina have mature ponderosa pine and Douglas-fir forests. Shrub steppe and grasslands characterize the lower elevations and private land. Most of the project area is in the Lake Chelan-Sawtooth Wilderness Area (see **Figure 1-2**, page 1-3). The Lakeshore Trail passes through the southern third of the project area and provides access to the wilderness for an estimated 1,854-visitors annually.

Section 1.2 – Current Law, Management Direction, and Guidance

This EIS is guided by Federal and State law, including the Forest and Rangeland Renewable Resources Planning Act (RPA), National Forest Management Act (NFMA), National Environmental Policy Act (NEPA), the Wilderness Act of 1964, the Washington State Wilderness Act of 1984, and the Clean Water Act.

1.2.1 Wenatchee National Forest Land and Resource Management Plan

Management direction for the project planning area is provided by the *Wenatchee National Forest Land and Resource Management Plan*, (WNF, 1990, the Forest Plan) as amended by the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (USDA, 1994; the *Northwest Forest Plan*). This document is tiered to the amended Forest Plan FEISs, and the accompanying documents are incorporated by reference.

The Forest Plan provides management direction in terms of Standards and Guidelines that may apply Forest-wide or to specific land allocations. Forest-wide standards and guidelines (page IV-89) include:

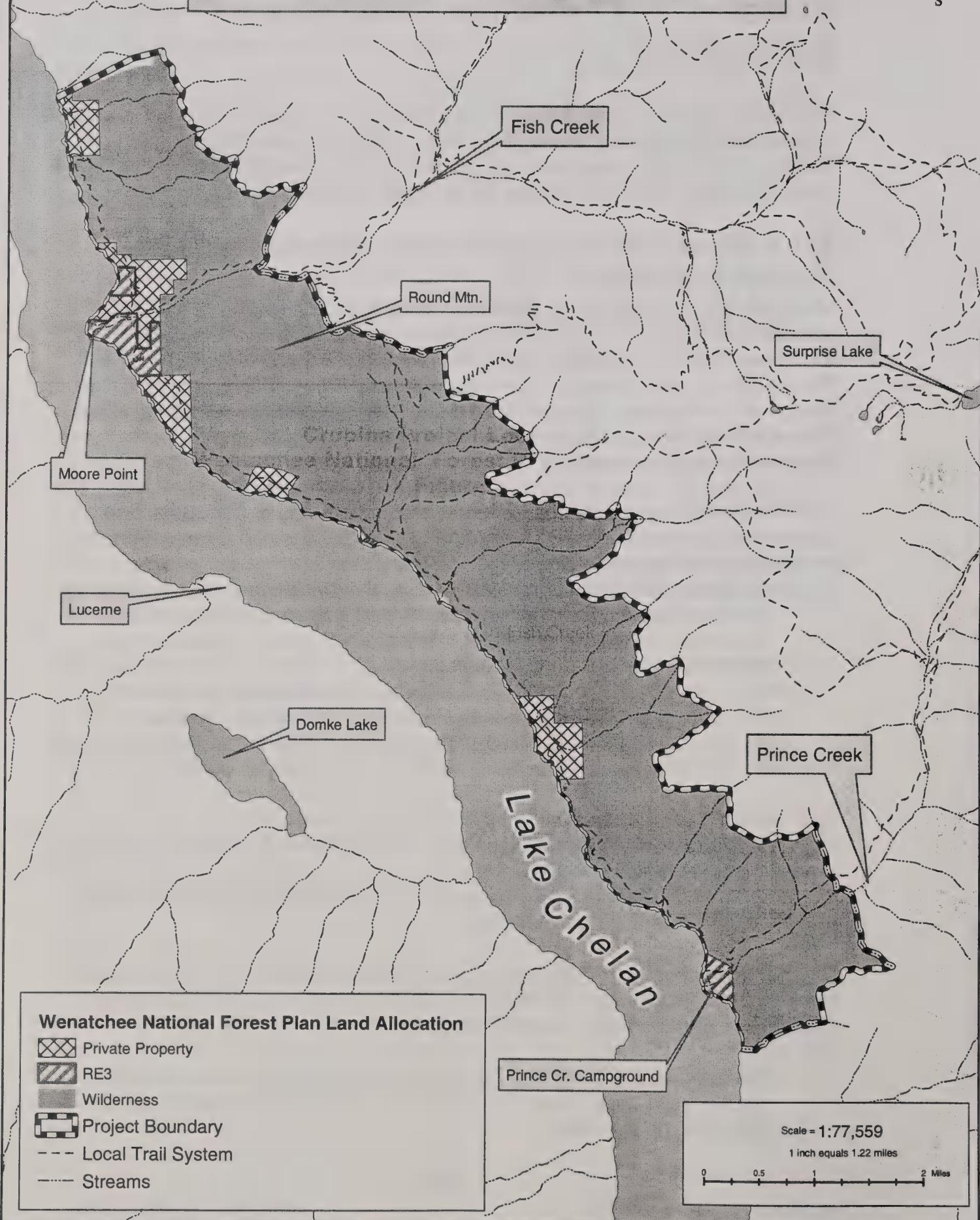
- 1) cooperate with state, county, and local agencies and organizations in the identification, location, prevention, and spread of noxious weeds; and
- 2) contain, control, or eradicate existing noxious weed populations as budget allows. Give priority as follows:
 - priority by noxious weed class (highest priority is class A)
 - priority by location (highest priority are lands with listed threatened, endangered, or sensitive plant species; next priority includes lands along the Forest boundary or wilderness)

The Forest Plan includes several land allocations (LAs) within the crupina project area (see **Figure 1-3**, WNF LA map, page 1-6 and **Table 1-1**, page 1-7). These are units of land to which a prescription or set of prescriptions is applied in order to achieve a particular management objective. The prescriptions define the type and intensity of resource activities that are or are not permitted.

WI-1 Wilderness (Semi-Primitive and Transition): Preserve and protect the natural character for future generations, and provide opportunities for solitude, challenge, inspiration, and scientific study.

The introduction of crupina has altered natural plant communities and processes in wilderness. Containment or control would reduce or eliminate the alteration.

Crupina Project Location Map
Wenatchee National Forest Plan Land Allocation
Figure 1-3



RE-1 Developed Recreation: Provide developed recreation in an urban to semi-primitive recreation opportunity spectrum (ROS) setting.

Existing developed recreation sites in the area infested with crupina (Prince Creek and Moore Point Campgrounds) are portals and vectors for noxious weed spread. LA direction provides for Integrated Pest Management to prevent further resource damage.

RE-3 Dispersed Recreation, Unloaded, Non-Motorized: Allow for dispersed recreation in an unloaded, semi-primitive, non-motorized, or primitive setting.

Existing trails, including the Lakeshore Trail, in the area infested with crupina are vectors for weed spread. LA direction provides for Integrated Pest Management to prevent further resource damage.

EW-2 Riparian-Aquatic Habitat Protection Zone: Maintain and enhance riparian management areas to perpetuate distinct resource values, achieve and maintain habitat conditions necessary to maximize long-term natural production opportunities for desired fish species, maintain water quality that meets or exceeds State standards, and provide diverse wildlife habitat.

Project activities would be limited in riparian reserves. Crupina density in riparian habitat is generally low due to the more productive nature of these types of habitat and better competitive abilities of native species under these conditions.

Table 1-1. Project area Forest Plan land allocation and private land acreage.

WI-1 Wilderness (Semi- Primitive and Transition)	RE-1 Developed Recreation	RE-3 Dispersed Recreation, Unloaded, Non- Motorized	EW-2 Riparian- Aquatic Habitat	Private Land	Total
9,126	5	238	Not mapped*	745	10,114

* EW-2 acreage overlays other land allocations and is not mapped separately. This land allocation corresponds with the riparian reserve land allocation in the *Northwest Forest Plan*.

1.2.2 The Northwest Forest Plan (NFP)

The *Northwest Forest Plan* amends the Wenatchee Forest Plan and uses an ecosystem management approach for management of old growth and late-successional forests within the range of the northern spotted owl. The NFP identified several land allocations for the crupina project area (see NFP Land Allocation Map, **Figure 1-4**, page 1-8). Wilderness land is designated Congressionally Reserved and other land is designated Administratively

**Crupina Project Location Map
Northwest Forest Plan Land Allocation
Figure 1-4**



Moore Point

Lucerne

Domke Lake

Prince Creek

Fish Creek

Round Mtn.

Surprise Lake

Northwest Forest Plan Land Allocation

- [Zebra pattern] Administratively Withdrawn
- [Solid gray] Congressionally Withdrawn
- [Cross-hatch] Private Property
- [Project Boundary] Project Boundary
- [Dashed line] Local Trail System
- [Dotted line] Streams

Prince Cr. Campground

Scale = 1:77,559

1 inch equals 1.22 miles



Withdrawn. The Riparian Reserve land allocation, a key element of the Aquatic Conservation Strategy (ACS) applicable to watersheds, overlays both designations. Riparian reserves are portions of watersheds where riparian-dependent resources receive primary emphasis and where specific standards and guidelines apply. Standards and guidelines prohibit and regulate activities in riparian reserves that retard or prevent attainment of the ACS objectives (ROD B-12). Project design criteria and mitigation measures are included in Chapter 2 to meet the ACS objectives. Weed infestations need to be considered in overall watershed/riparian restoration programs in order for ACS objectives to be fully attained.

The NFP requires that some species associated with late-successional conditions be managed to improve the likelihood of maintaining viable populations. These species include mosses, lichens, liverworts, fungi, vascular plants, amphibians, and mollusks. Survey and manage (S&M) or protection buffer (PB) species (see Table C-3 in the *ROD*) are managed under the "survey and manage" standard and guideline in the NFP. Primary habitat for these species are moist, shady sites on or associated with dead wood or litter, mossy rocks, talus, alpine sod, and trees boles, branches or roots. Environmental documentation for these species is included in the vegetation and wildlife sections of Chapter 3.

1.2.3 Middle Chelan Watershed Assessment

The Middle Chelan Watershed Assessment (WNF, Chelan RD) was completed in 1999 and is incorporated by reference. It characterized human, aquatic, riparian, and terrestrial features, as well as conditions, processes, and interactions in the watershed. The assessment found that cripina is a concern for wildlife and sensitive plants because it reduces the availability and diversity of forage and it competes with native vegetation. A desired condition would be to reduce heavy cripina infestations and control spread. The assessment identified completion of a strategy to control cripina as a high priority. The watershed assessment was completed prior to the large increase in potential cripina habitat from wildfires.

1.2.4 Interior Columbia Basin Ecosystem Management Project (ICBEMP)

This Bureau of Land Management (BLM) and Forest Service project was guided by integrated ecological assessments and strategies to "develop a scientifically sound and ecosystem-based strategy for management of eastside forests". The *Integrated Science Assessment for Ecosystem Management in the Interior Columbia Basin* (USDA, 1996) is the work of the Science Integration Team of ICBEMP. The document provides an assessment of ecosystem status for the Columbia River basin.

Research from scientists involved in the ICBEMP has shown that disturbances related to fire and insect mortality have an important role in determining forest composition throughout the interior Columbia Basin. Forested ecosystems have become more susceptible to severe fires, outbreaks of insects and diseases, and invasion by exotic plants--noxious weeds. A key finding is that noxious weed spread is expected to accelerate in the Columbia Basin.

The susceptibility of Columbia Basin vegetation cover types to invasion and the distribution of twenty-five exotic plants, including crupina, are described in *An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume II* (USDA, 1997). This document is incorporated by reference. A "susceptibility to invasion index" describes which cover types are most at risk of invasion by exotic plant species.

1.2.5 Guides to Noxious Weed Prevention Practices

In terms of weed management, direction is provided in the *USDA-Forest Service Guide to Noxious Weed Prevention Practices* (USDA, 2001) and the *Okanogan and Wenatchee National Forests Weed Management and Prevention Strategy* (OWNF, 2002). These documents are incorporated by reference, and each supports implementation of Executive Order 13112 on Invasive Species (February 3, 1999). The order directs all Federal agencies to use relevant programs and authorities to:

- 1) prevent the introduction of invasive species;
- 2) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner;
- 3) monitor invasive species populations accurately and reliably;
- 4) provide for restoration of native species and habitat conditions in ecosystems that have been invaded;
- 5) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and
- 6) promote public education on invasive species and the means to address them.

The order also directs agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species.

The Final Environmental Impact Statement (FEIS) for Managing Competing and Unwanted Vegetation (USDA, 1988) and the associated Mediated Agreement (1989) do not apply to wilderness land. The 1988 FEIS does apply to National Forest System land in the project area that is outside of wilderness. All project activities were designed to be consistent with portions of the FEIS and Mediated Agreement (incorporated by reference) that are still considered the best science available. New information, such as recently completed herbicide risk assessments (USDA, 2003a, b) supercedes the 1988 FEIS and is incorporated in this analysis.

Section 1.3 – Purpose and Need for the Proposed Action

The Forest Plan has forest-wide management direction to contain, control, or eradicate existing populations of noxious weeds (WNF, 1990 pages 89, 92), with top priority given to Class A weeds and high priority given to those weeds found in wilderness areas. Additionally, the Wilderness Act requires areas be protected and preserved for wilderness character. The Middle Chelan Watershed Assessment (WNF, 1999) describes a desired condition with reduced crupina infestations and controlled spread. Completion of a strategy to control crupina is a high priority.

Regarding wilderness, for proposed activities that might entail the use of motorized equipment or mechanical transport, a separate analysis using the Minimum Requirement Decision Guide is required. The analysis for the portion of the proposed project area that is in the Lake Chelan-Sawtooth Wilderness Area was completed prior to project scoping. It considered the need for action in wilderness, a range of actions, and the decision to be made. The analysis helped guide the decision to prepare this FEIS and aided in alternative formulation. A copy of the analysis is located in the project file.

The Okanogan and Wenatchee National Forests are proposing to implement long-term integrated weed management to contain and control the spread of crupina. State and Federal laws and regulations also require control and, if possible, eradication of crupina. The integrated strategy for managing various pests, including noxious weeds is defined in Forest Service Handbook FSH 3409 (Forest Service Pest Management). Integrated weed management is defined in FSM 2080.5 (Noxious Weed Management). An integrated approach is necessary in weed management because using only a single method has been less than successful.

While efforts to limit the spread of crupina to areas other than the north shore of Lake Chelan have worked, attempts to eradicate crupina have not been successful. For a number of reasons, hand-pulling has been the only treatment method used on National Forest System lands. While hand-pulling, hoeing, or other tillage is the best treatment in and adjacent to homesites, sensitive areas, or where infestations consist of a few plants that can be inspected frequently (Prather *et. al.*, 1991), limited access and the rugged terrain at Lake Chelan are jeopardizing previous weed treatment efforts. The other factors that warrant consideration include available funding to address the spread of noxious weeds and the large increase in area available for invasion by crupina due to recent fires. On wilderness land, crupina is reducing native ecosystem biodiversity and compromising the wilderness resource, other resource values, and ecosystem integrity. This is counter to a precept of wilderness management that states maintenance of ecosystems should develop and respond to natural forces. The purpose of the Crupina IWMP is to contain, control, and move toward the eradication of crupina in the current area of infestation near Lake Chelan. Action is needed:

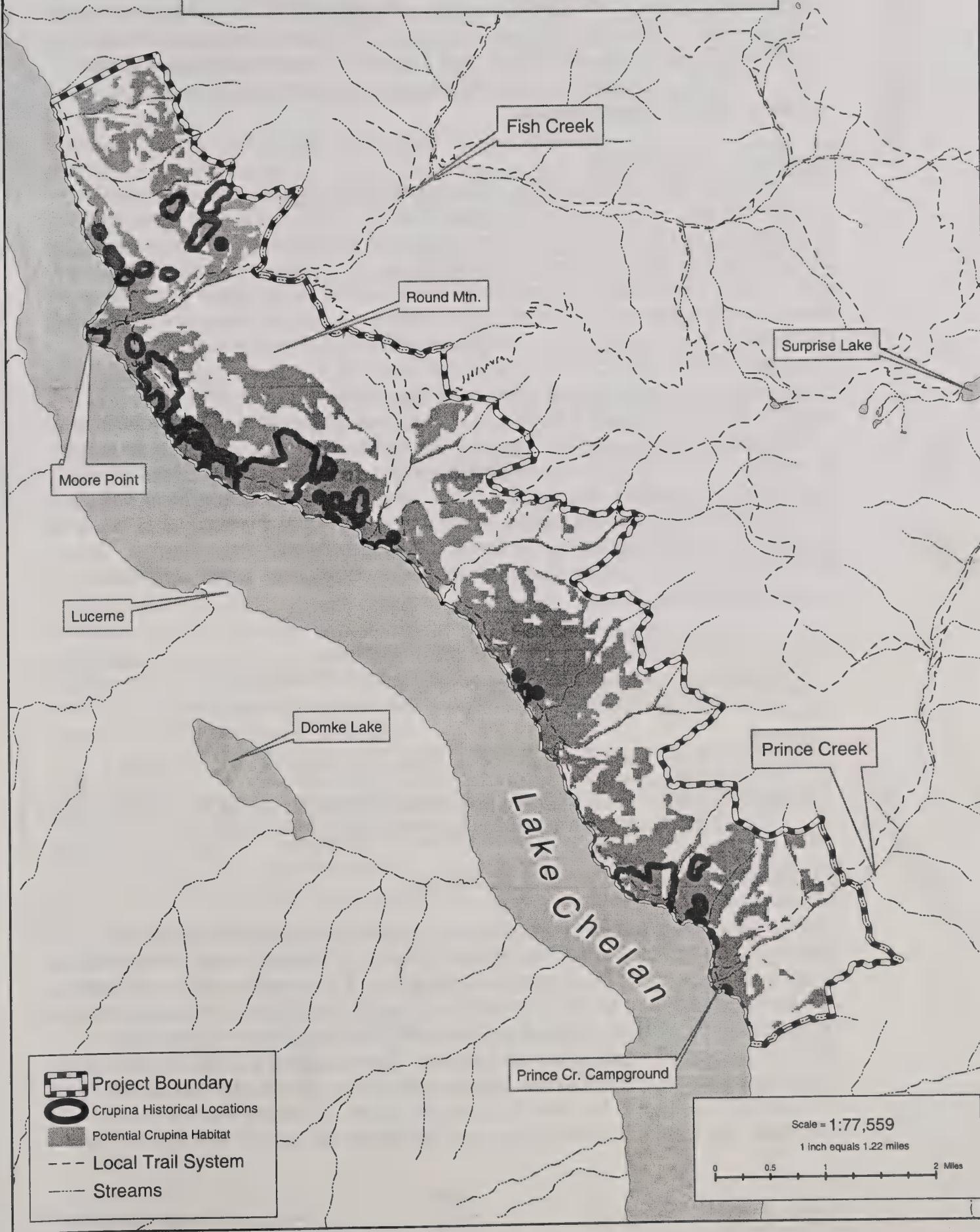
- to protect the biodiversity of the middle Chelan watershed by limiting the spread, controlling, and eventually eradicating crupina, a non-native, Class A noxious weed;
- to protect or restore ecosystem integrity, specifically native vegetation and unique habitats including wetlands and sensitive plant populations;
- to protect wilderness values and resources;
- to prevent potential spread of crupina to other land up- and down-lake from the current infestation and on to about 4,500-acres of suitable habitat created by the 2001 Rex Creek wildfire;
- to prevent the potential spread of crupina to other land outside the analysis area;
- to limit the spread, control, and eventually eradicate known populations of crupina on trails, campsites, and wildlife forage habitat;
- to improve the effectiveness of current treatment methods;
- to control the invasion of perennial weeds and cheatgrass after treatment of crupina.
- to cooperate with landowners to treat crupina on private land adjacent to the National Forest (requires consent from landowners).

Section 1.4 – Proposed Action

Background

In 2004, the Supervisor of the Okanogan and Wenatchee National Forests proposes to begin implementation of a multi-year integrated weed management strategy to treat a total of about 500-acres of crupina, with about 250-acres located in the Lake Chelan-Sawtooth Wilderness Area (see proposed action map, **Figure 1-5**, page 1-13).

Crupina Project Location Map Proposed Action Figure 1-5



The Rex Creek wildfire burned areas infested with crupina and increased the susceptibility and risk of crupina invading suitable habitat. In addition to the 500-acres already infested by crupina, up to about 200-acres per year could be treated within the 4,500-acre Rex Creek fire area if crupina spreads into that area. The areas suitable for invasion by crupina were modeled using the following habitat characteristics.

Suitable Crupina Habitat

Suitable crupina habitat consists of dry south-facing slopes with rocky and/or sandy soils and extending from the lakeshore to 1,000-2,000 feet above the lake in elevation (see **Table 1-2**). These areas support grassland, shrub steppe, or open forest habitats. Crupina colonizes areas of bare mineral soil and prefers full sun. Due to the increased shade and cover crupina rarely grows in dense or closed canopy forests. Established native perennial plants are more resistant to competition from crupina than young perennials and native annuals.

Disturbances that reduce the cover of native plants increase crupina habitat. Past livestock grazing, home, road, campground, and trail construction, and wildfires increased crupina habitat. The increase of potential habitat following a wildfire can be temporary if the native plant community is in good condition prior to the fire. Native plants are adapted to wildfire and are typically stimulated by sprouting or increased seed germination. However, areas would likely remain crupina habitat long-term in areas where perennial native plant cover is low and crupina and other weeds such as cheatgrass are present before the fire. Only the establishment of native, perennial plants on these sites would decrease habitat for crupina.

Table 1-2. Suitable Crupina Habitat Characteristics.

Parameter	Habitat Characteristics
Aspect	Southwest, South, and West
Slope gradient	0-60%
Soil type	Stony, sandy loams and rock outcrops: C3810/3811, C2600, C1769; and CW (lakeshore)
Elevation	90% of current infestation located from 1,100-2,000 feet. Model includes areas up to 4,100 feet due to added suitability provided by Rex Creek fire

Crupina Life History and Vectors for Spread

Crupina is a winter annual; seeds usually germinate in the fall and over-winter as rosettes. Fall germination allows crupina to take advantage of early spring moisture before native plants are actively growing. Crupina seeds remain viable for up to three years. This strategy allows some of the seeds additional time to drill down into the litter to reach mineral soil, and allows for survival of a portion of the seed bank if wildfires remove top layers of the litter. Crupina bolts in the spring (April and May), and flowers by June. Seeds typically drop near the base of the parent plant, leading to the formation of dense stands of crupina. Wind can spread seeds up to five feet from parent plants. Rodents can carry seed up to 50-feet, and cattle and deer can move the seeds on hooves and hair at least

300-feet from parent plants (Prather *et al.*, 1991). Livestock and wildlife may transport ingested seed for greater distances before excretion. Humans may transport the seed in clothing or on gear (Kimberling *et.al.*, 2003). Crupina seed may be transported in rivers or streams (Sheley and Petroff, 1999). It is not known how long crupina seed could float in a lake and remain viable.

Fall germination, early seed maturation, the ability of the seed to drill through the litter layer into the topsoil, and delayed germination of a portion of the seed bank, all contribute to the difficulty of crupina control and eradication. Factors that contribute to crupina control efforts include poor competitive ability where native vegetation and tree overstory are present, annual habit (inability to re-sprout from the root), relatively easy hand-pulling, and relatively short-term viability of seed (three years or less).

Proposed Action

Efforts to control the crupina infestation near Lake Chelan emphasize a multi-year, long-term integrated weed management strategy on both National Forest System and private lands. Sites with the greatest risk of spread would be a priority for treatment, focusing on the perimeter, or up- and down-lake edges, of the infestation and working toward the center. Other priority areas include boat landings, trails, and campsites that have potential for the transport of crupina seeds. All known treatment methods would be considered to achieve long-term resource objectives. The word "control" refers to elimination or reduction of crupina. Site-specific resource objectives and goals determine the level of control desired for specific populations of crupina. An integrated weed management approach would use a combination of treatment and control methods including **manual** (hand-pulling), **mechanical** (radian heat disks), **cultural** (seeding), and **chemical** (herbicides). The Proposed Action is presented as Alternative C in this EIS.

Note: Mechanical (*i.e.* radiant heat disk) treatment methods for noxious weed management are referenced in the definition of integrated weed management (Forest Service Manual, 2080.5). This terminology is distinct from the definition of motorized use and mechanical transport in wilderness (FSM 2320.5). Motorized use refers to machines that use a motor, engine, or other non-living power source. Motorized use does not include propane-powered hand-carried devices such as the radiant heat disk.

The area proposed for treatment is about 0.5-percent of the approximate 92,000-acres in the middle Chelan watershed. The current crupina infestation occurs in patches that vary in size from a few plants to stands that cover about 55-acres. In most infested areas crupina does not make up all of the ground cover. For instance, an area about two acres in size might have crupina plants in scattered clumps that cover a few square feet. Therefore, control efforts would be confined to a substantially smaller area than that reflected in the total infestation acreage.

The treatment methods for each site infested with crupina would include a combination of the following methods:

- chemical: spot application using backpack sprayers; herbicide picloram in upland areas and glyphosate near water;
- manual: hand-pulling, grubbing;
- mechanical: radiant heat disk (propane fueled);
- cultural: seed treated areas using native sources especially where non-native vegetation (*e.g.* cheatgrass) might re-occupy the site.

To implement each of the treatment methods, the Proposed Action includes the limited use of motorized equipment and mechanical transport in wilderness.

The treatment method for a given site would be selected using the following criteria:

- proximity to threatened, endangered, or sensitive plants with potential to be impacted by herbicide spray or drift—hand-pull only;
- areas that are 10 to 50-feet from wetted stream edges and areas with sandy soil and a high water table—hand-pull and/or glyphosate;
- areas that are within 10-feet of wetted streams—hand-pull only;
- dense patches of crupina that are separated from other vegetation that could burn---radiant heat disk;
- areas with a few scattered crupina plants that are distant from water for mixing herbicides---hand-pull or radiant heat disk;
- areas where native plants comprise ≥95% of total vegetative cover—hand-pull;
- areas where native plants comprise ≤25% of total vegetative cover—herbicide (glyphosate);
- on steep rocky areas and rock outcrops that are unsafe for foot traffic, buffer areas would be treated according to the above criteria to contain weed spread.

First-year treatments would likely not be completely effective since dormant seeds present would germinate in following years. Monitoring would determine follow-up treatment as needed. This would likely be at successively reduced levels, especially use of herbicides, as the seed bank is depleted. As additional infestations of crupina are discovered, there would be an evaluation to determine if the site fits within the scope of this EIS and then prioritized for treatment. Future control sites would be treated using the established criteria and the analysis conducted in this EIS. Treatment of additional sites would be under an adaptive management strategy. The project includes the potential for cooperative weed treatments on adjacent private lands to control crupina, however, such treatment would require consent from landowners.

Section 1.5 – Responsible Agency and the Decision to be Made

The scope of the decision is limited to activities presently proposed for the project area. The Okanogan and Wenatchee Forest Supervisor has been delegated the authority as the deciding official for this project. The decision options include:

- Whether or not to implement weed treatment activities. If so, identify the site-specific locations of appropriate treatments.
- Whether or not to use herbicides, or motorized equipment (pumps) and mechanical transport (helicopters) in wilderness.
- If weed treatments are chosen, what mitigation and monitoring is needed to protect resources.

Section 1.6 – Public Involvement

Initial public involvement regarding the Lake Chelan crupina infestation began in 1990 and 1991 with scoping for an environmental assessment. A decision was made to hand-pull crupina. In 2001, following the Rex Creek wildfire, a public meeting was held to discuss potential rehabilitation treatments in the burned area. One of the topics at this meeting was the need for additional treatment of crupina in light of the vast area without vegetation. A scoping letter for the current proposed action was mailed in June 2002, accompanied by newspaper and radio notices. In October 2002 a letter was sent to private landowners within the boundary of the project area to ask for interest in participating to control crupina. A second letter to private landowners scheduled a meeting to discuss potential crupina treatments.

A notice of intent (NOI) to prepare an environmental impact statement for the project was first published in volume 67, number 201 of the Federal Register, on Thursday, October 17, 2002. A revised NOI with a project name change was published in volume 68, number 72, of the Federal Register on April 15, 2003. A second revised NOI to change the responsible official was published August 5, 2003 in volume 68, number 150 of the Federal Register. Comments were received from several individuals, agencies, businesses, and organizations before the Draft EIS was published. Public comments were received in the form of letters, electronic mail messages, phone calls, and personal visits.

A Draft Environmental Impact Statement (DEIS) was prepared in August 2003 with notice published in volume 66, number 172, of the Federal Register on September 5, 2003. Comments on the DEIS were due by October 20, 2003. Three comment letters were received, two from public agencies (see **Appendix J**), and one from an individual with property adjacent to a portion of the proposed treatment area (see **Appendix K**).

Section 1.7 – Issues

The interdisciplinary team used the comments received during scoping to identify potential conflicts and develop issues. A list of issues was developed and after review, some issues were withdrawn from analysis because broader effects analysis addressed them adequately; because they were outside the scope of the project; or because prescribed mitigation measures resolved potential conflicts.

The entire list of issues and how they were addressed is in the analysis file. Although a number of comments were received, few contained issues related to the proposed action. Most comments were either resolved through incorporation into the proposed action, or were outside the scope of the purpose and need for this project. Some comments supported the Forest Service proposal to control, and move toward eradication of crupina. Correspondence and responses to scoping letters are documented in the project analysis file. The following Key Issues were used to develop alternatives to the proposed action.

1.7.1 Key Issues

The following issues were formulated from concerns identified during the scoping process.

KEY ISSUE 1: Herbicides have the potential to effect human health, plants, wildlife, fish, water quality, and soil.

There is a concern that use of herbicides to control weed infestations would have potential impacts on human health. Potential effects on human health from herbicide use are addressed and considered by the EPA, as well as the Forest Service. A list of references that includes assessing risk to human health is contained in **Appendix A**.

Issue Indicators:

- Potential for herbicide exposure; measured by toxicity levels in terms of safe reference doses (RfDs).
- Herbicide application in accordance with Forest Service Manual 2150 (Pesticide-Use Management and Coordination Handbook); measured in acres of herbicide treatment.
- Herbicide application in accordance with Forest Service Handbook 2109.14 (Pesticide-Use Management and Coordination Handbook); measured in acres of herbicide treatment.
- All crupina treatments consistent with the Okanogan and Wenatchee National Forests Hazard Communication Program and Forest Service Handbook 6709.11 (Health and Safety Code Handbook); measured in acres of herbicide treatment.

There is also concern about effects of herbicides used for crupina control on water quality and other biological resources on National Forest System land. Concerns include the direct, indirect, or cumulative effects from the use of herbicides on project area water quality, soil, and the habitat for plant, wildlife, and aquatic species.

Issue Indicators:

- Impacts that exceed regulatory compliance thresholds and potential impacts of herbicides to non-target resources; measured in acres of herbicide treatment.
- Shrub steppe habitat threatened by crupina infestations (mule deer winter and spring range, grizzly bear spring emergence habitat, bald eagle winter/spring foraging habitat); measured in terms of a trend to native vegetation recovery based on crupina treatment acreage.
- Temporary disturbance to security/core habitat from crews; measured by crupina treatment acreage.
- Temporary disturbance to security/core habitat from motorized equipment; measured by crupina treatment acres with support from motorized equipment.

KEY ISSUE 2: The proposed weed treatments have the potential to effect wilderness values.

The use of motorized equipment and mechanical transport (pumps and helicopters) in the wilderness can affect wilderness values. Noise can disturb both wildlife and recreationists, affecting the quality of wilderness experience. Public concern was also expressed regarding use of herbicides in wilderness. Some feel the proposed treatments are inconsistent with the 1964 Wilderness Act (P.L. 88-577). Although legislatively protected, all wilderness areas have been impacted to some degree by human disturbances. Among these disturbances is the introduction of invasive exotic plants. Managers are charged with the responsibility of maintaining the enduring resource of wilderness. The Wilderness Act mandates that "wilderness be managed so its community of life is untrammeled by man, its primeval character is retained, and its natural conditions are preserved" and to "assure that an increasing population, accompanied by an expanded settlement and growing mechanization, does not occupy and modify all areas within the United States." Forest Service direction is to maintain wilderness in such a manner that ecosystems are unaffected by human manipulation and influences so that plants and animals develop and respond to natural forces (FSM 2320.2).

Issue Indicator:

- Effects on wilderness integrity (values and experiences); measured by crupina treatment acres and trend to recovery of native vegetation.

1.7.2 Other Measurements of Change

In addition to resources associated with the Key Issues, the effects the alternatives have on a variety of other resources are disclosed. These resources are managed under Forest Plan Standards and Guidelines. The effects the alternatives have on these resources are described in Chapter 3 of this EIS. They include:

- Vegetation (native vegetation, sensitive plants, competing and unwanted vegetation)
- Terrestrial wildlife species and habitats (threatened, endangered, and sensitive designations; management indicator species)
- Fish species and aquatic habitat
- Wilderness
- Recreation facilities and visitor use
- Heritage resources
- Scenery
- Roadless character

Chapter 2 Alternatives

Chapter 2 changes between the Draft and Final Environmental Impact Statements:

Two mitigation measures were added:

No herbicides will be used within 100-feet of the Swartz property boundary and water source. The property owner expressed concern about the use of herbicides adjacent to the property.

Sanitation requirements will be implemented for camps used during weed treatments to discourage grizzly bears, a threatened species. This mitigation was suggested by the U.S. Fish and Wildlife Service during consultation.

In addition, the mitigation measure regarding party size on page 2-11 of the DEIS was clarified. Although wilderness users are limited to certain party sizes by Forest Plan standards and guidelines, the Forest Plan allows flexibility when larger party sizes are needed for administrative purposes. Although the Forest Plan encourages restricting administrative parties to the same size as wilderness uses, the use of the word "should" rather than "shall" or "will" provides some discretion.

Other changes to Chapter 2 are minor.

Chapter 2 Alternatives Including the Proposed Action

This chapter describes the alternatives, including the proposed action for the Crupina Integrated Weed Management Project (Crupina IWMP). The primary objective of the alternatives is to present the public and the decision maker with a reasonable range of alternatives that display the effects on these issues. The interdisciplinary team used context and intensity to classify issues derived from comments from the public, organizations, agencies, and others. From this, several key issues evolved: 1) effects on **human and ecosystem health** from the use of **chemical herbicides**, and 2) effects on **wilderness values**. These were used to develop a range of alternatives. To respond to the issues, alternatives were developed to utilize non-herbicide treatment methods, eliminate the use of motorized equipment and mechanical transport for logistical support in wilderness. The resulting action alternatives and the No-Action alternative are described below.

Section 2.1 – Alternative Descriptions

2.1.1 The Alternatives

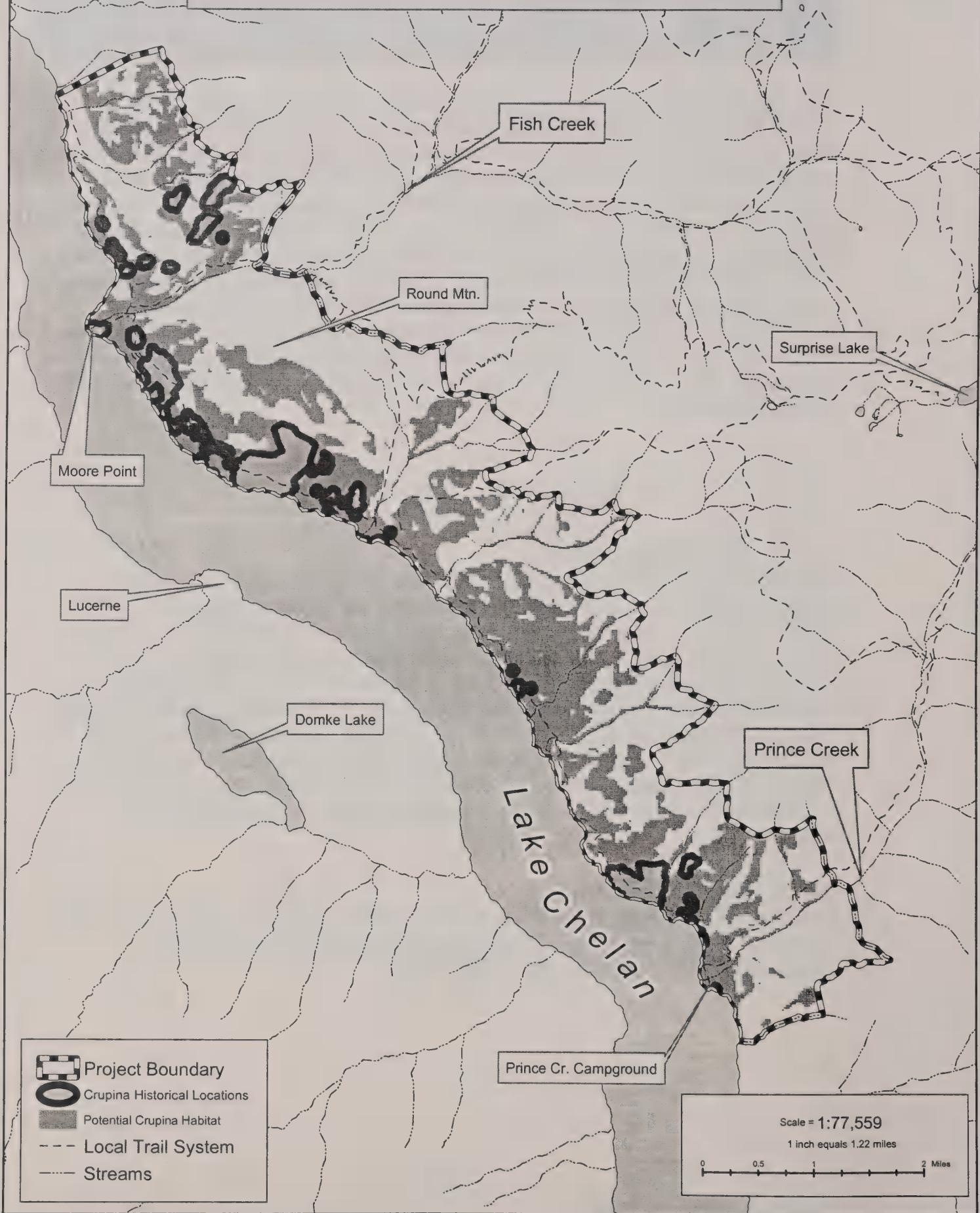
The Proposed Action includes several treatment methods and the use of motorized equipment and mechanical transport for logistical support in wilderness. The action alternatives address treatment methods and implementation in wilderness to some degree and include measures to mitigate effects. A map (see next page) of the project area is provided that shows proposed treatment locations based on the current locations of crupina. Discrete maps for Alternatives B, C, and D are not provided since each alternative would treat the existing crupina infestation but with different treatment methods. A decision to select any of the action alternatives would affect exact location, acres by treatment method, and when treatment would occur during the project timeline.

Alternative A (No Action)

With this alternative there would be no action taken regarding the current crupina infestation in the project area. This alternative serves as a baseline for comparison of the effects of other alternatives.

K-2-1

Crupina Project Location Map
Alternative Map Figure 2-1



Alternative B (Only Hand-pulling Used)

This issue responds to the key issue related to the use of herbicides. With this alternative, hand-pulling would be the only treatment method used to implement crupina weed management in the project area. Priority areas for treatment would be determined using the criteria listed below in section 2.1.2 (Features Common to Action Alternatives). Up to a maximum 100-acres per year in areas infested with crupina would be treated. The 100-acre figure is based on recent experience with hand-pulling treatments. Limited access points and rugged terrain are the primary limitations. Most of the identified areas would be treated for three seasons in succession. There would be no chemical or mechanical methods used, though seeding would occur (see section 2.1.2, Features Common to Action Alternatives). Wilderness land would be treated. Hand-pulling would utilize up to 42-persons (1,920 worker-days), with a limit of 21-persons at any wilderness location.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

This alternative is the Proposed Action that would use several treatment methods to implement integrated weed management in the project area. Priority areas for treatment and the treatment method selected would be determined using the criteria listed below in **section 2.1.2** (Features Common to Action Alternatives). This alternative would allow herbicides and the use of motorized equipment (pumps) and mechanical transport (helicopters) for logistical support in some areas of wilderness. Hand-pulling and cultural (seeding) treatment would be as described in Alternative B with a maximum treatment area of about 100-acres per year.

Mechanical treatment (see **note** below) would utilize a radiant heat disk for areas with a few crupina plants and areas where herbicide use may not be desirable because of safety, terrain, and distance from water for mixing. The combined acreage for both hand-pulling and the radiant heat disk would not exceed a maximum of 100-acres per year.

Note: Mechanical (*i. e.*, radiant heat disk) treatment methods for noxious weed management are referenced in the Forest Service Manual (FSM 2080.5) definition of integrated weed management. This is distinct from the definition of motorized use or mechanical transport in wilderness (FSM 2320.5). Motorized use refers to machines that use a motor, engine, or other non-living power source and does not include propane-powered hand-carried devices such as the radiant heat disk.

The herbicides picloram or glyphosate would be used according to label instructions. Generally, use of picloram would occur in non-riparian areas. Glyphosate would be used for crupina infestations in locations that are 10 to 50-feet from the wetted stream edge (a portion of the riparian reserves) and areas with sandy soil and a high water table. Glyphosate use would also be indicated for areas with little or no native vegetation.

Up to 10-persons (five, two-person crews) would use backpack sprayers or hand-operated wicks for herbicide treatments. Up to about 100-acres would be treated with herbicides each year. No herbicide use would occur within 10-feet of the wetted stream edge, other surface water, or within 25-feet of known locations with threatened, endangered, or sensitive plant species. Most areas treated with herbicide would receive more than one treatment over the 10-year project timeline. Some areas would be sprayed with herbicide with follow-up hand-pulling or mechanical treatment. There may be conditions under which no herbicide treatment is implemented for a given year.

Motorized equipment (pumps) would be used in select locations as needed for water to facilitate mixing and application of herbicides. With this alternative, mechanical transport (helicopter) could be used up to once a week during the treatment window (mid-March through mid-June) to provide logistical support as needed for each treatment method. The helicopter would be used to transport equipment and personnel to existing helispots or other suitable open areas. No additional helispots would be constructed. In some cases, the helicopter would hover and not land, with equipment delivered via a long-line.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Motorized Equipment or Mechanical Transport in Wilderness)

This alternative responds to the key issue related to effects on wilderness values and integrity. This alternative would use several treatment methods to implement integrated weed management in the project area. Hand-pulling, seeding, herbicides, and radiant heat disks would be used as described above in Alternatives B and C. Priority areas for treatment and the treatment method selected would be determined using the criteria listed below in **section 2.1.2**. This alternative is different from Alternative C in the following ways:

- Crupina treatment in wilderness would be non-mechanized—the use of motorized equipment (pumps) and mechanical transport (helicopters) for logistical support in areas of wilderness would be prohibited.
- Herbicide treatment acreage would be reduced to about 50-acres (10-acres in wilderness) per year and include only areas close to boat access from the lakeshore, private land, and areas adjacent to private land. Without the use of motorized equipment and mechanical transport for logistical support in areas of wilderness there would be terrain, safety, and operational limitations that diminish the herbicide treatment area.
- About 100-acres maximum per year would be treated by a combination of hand-pulling or radiant heat disks.

2.1.2 Features Common to Action Alternatives (B, C, or D)

The action alternatives propose similar treatment methods for up to 500-acres infested with crupina. This section provides a description of elements that are common to Alternatives B, C, or D.

Weed Prevention Strategy

The treatment of noxious weeds and competing vegetation in the project area would emphasize prevention.

1. To prevent the spread of crupina, treat infested areas and those areas (see priority criteria below) that have the greatest potential for weed spread.
2. Provide information to contractors as well as Forest Service employees conducting soil disturbing activities within the project area about existing noxious weeds of concern, as well as about practices which would reduce the introduction and spread of noxious weeds during activities (OWNF, 2002).
3. Provide information to recreationists and others who travel through infested areas on weed identification and growth habits. Post signs at boat landings, trailheads, campsites, or other access points. Recommend that people check clothing and shoes on leaving the infested area so that weed seeds and plant parts are not transported from the area.
4. Contractors and/or Forest Service employees need to inspect, remove, and properly dispose of noxious weed seed and plant parts found on clothing and equipment prior to leaving a project site.
5. Annually inspect boat landings, campsites, trailheads, and trails open to public use for weeds. Immediately hand-pull any newly invading noxious weeds before they become established if appropriate for the given species. Map the site so that it can be monitored. Avoid or minimize unnecessary travel through weed-infested areas, or restrict travel to periods when the spread of seed is least likely.
6. Use noxious weed free native seed for the State of Washington for seeding or planting activity.
7. Seed disturbed sites based on site-specific prescriptions and minimize the time between ground-disturbing activity and recovery.
8. Inventory staging areas prior to starting work and develop a site-specific plan for the treatment of existing noxious weeds. Immediately hand-pull any newly invading noxious weeds before they become established if appropriate for the given species. Map the site so that it can be monitored. Avoid or minimize unnecessary travel through weed-infested areas, or restrict travel to periods when the spread of seed is least likely.
9. Continue to encourage agencies and residents to treat private land adjacent to National Forest System land in the project area.

Cultural Treatments (Seeding Strategy)

After crupina treatments, follow-up cultural treatment (seeding) would occur with each action alternative. Generally, seeding would occur where the native plant population is compromised. The extent of seeding and whether to seed some areas would depend primarily on the degree of disturbance to native vegetation (see **Table 2-1**). Areas with soil disturbance would be seeded with native bunchgrass or yarrow. Only native source seed or native cultivars previously seeded in the area would be used in cultural treatments. Chelan District personnel collected and propagated local native blue bunch wheatgrass and yarrow. This seed would be used as quantities last, with priority seeding on wilderness land. After the Rex Creek wildfire, known crupina infestations were seeded with a mix of native cultivars; this mix would also be used in crupina treatment areas if the supply of local native seed is depleted. Seeding would be done when there is adequate soil moisture either in the fall following spring weed treatments or in early spring the year after weed treatment.

Table 2-1. Criteria for seeding.

Relative Degree of Disturbance to Native Vegetation	% Native Plant Cover	Seeding Strategy
Light	$\geq 95\%$	Seeding not needed
Moderate	26- 94%	Possible, depends on plant composition
Heavy	$\leq 25\%$	Probable

Crupina Treatment Method Criteria

Crupina treatment method would depend on site-specific conditions.

1. proximity to threatened, endangered, or sensitive plants with potential to be impacted by herbicide spray or drift—hand-pull only;
2. areas that are 10 to 50 feet from wetted stream edges and areas with sandy soil and a high water table—hand-pull and/or glyphosate;
3. areas that are within 10-feet of wetted streams—hand-pull only;
4. dense patches of crupina that are separated from other vegetation that could burn---radiant heat disk;
5. areas with few scattered crupina plants that are distant from water for mixing herbicides---radiant heat disk;
6. on steep rocky areas and rock outcrops that are unsafe for foot traffic, buffer areas would be treated according to the above criteria to contain weed spread;
7. areas where the composition of native plant community is compromised—hand-pull or herbicide (see below);
 - where native plant cover is $\geq 95\%$, the probable treatment method would be hand-pulling;
 - where native plant cover is 26-94%, the probable treatment method would be hand-pulling or herbicide;
 - where native plant cover is $\leq 25\%$, the probable treatment method would be herbicide.

Crupina Treatment Priority Criteria

The order of listed priorities could change annually, and over the project lifespan, based on the results from previous crupina treatments.

1. crupina infestations along or near boat landings, trails, trailheads, and campsites (areas with the potential for weed spread from human vectors);
2. crupina infestation area perimeters (up- or down-lake);
3. crupina infestations in close proximity to sensitive plant locations or other TES habitats;
4. infestations with a high density of crupina;
5. crupina infestations in close proximity to habitat with the potential for further weed spread (*i.e.* the Rex Creek wildfire); and
6. crupina infestations in close proximity to private land with the potential to allow transport of seed out of the infested area;
7. crupina infestations on private land with the potential to allow transport of seed out of the infested area (this would require consent and cooperation from landowners)

Crupina Treatment Timing

The treatment period for crupina generally extends from mid-March to mid-June. This treatment window could vary annually depending on environmental conditions that influence plant growth. During project implementation, daily weather forecasts (such as chance of precipitation and wind) would also be monitored to determine suitability for herbicide application.

2.1.3 Mitigation Measures for Action Alternatives

These measures are used to reduce negative effects on project area resources. They are considered part of the alternatives and will be incorporated as such. All mitigation measures listed are common to the action alternatives (B, C, or D) unless otherwise noted and would be required if one of the action alternatives is implemented. In general, all action alternatives incorporate the mitigation associated with Forest Plan standards and guidelines, as amended. A spill plan is located in **Appendix B**.

Herbicide Treatments (Alternatives C & D only)

1. Herbicides will be applied in accordance with Forest Service Manual 2150 (Pesticide-Use Management and Coordination). This identifies the authority for Forest Service use of pesticides (the Federal Insecticide, Fungicide, and Rodenticide Act) and establishes the objectives and responsibilities of managers on all administrative levels. It describes the requirements for environmental documentation, safety planning, and training.

2. Forest Service Handbook 2109.14 (Pesticide-Use Management and Coordination Handbook, Chapter 10) will be used for project planning. This establishes procedures to guide organizing, conducting, and reporting pesticide use projects. It also describes the requirement for a post-treatment evaluation report and pesticide-use report. Other direction in FSH 2109.14 would be met, including project type and personnel (Chapter 30); herbicide storage, transportation, and disposal (Chapter 40); quality control, monitoring, and post-treatment evaluation (Chapter 50); and spill, accidents, and incidents (Chapter 60).
3. The Okanogan and Wenatchee National Forests Hazard Communication Program in compliance with the Federal Occupational Health and Safety Codes 29CFR 1910.1200, Hazard Communication would be implemented. The program applies to all personnel on the Okanogan and Wenatchee National Forests, including employees, contractors, or vendors. Components of the program include the Material Safety Data Sheets (MSDS), container labeling, the Hazardous Material Spill Plan, and employee training.
4. Forest Service Handbook 6709.11 (Health and Safety Code Handbook, Chapter 60, Hazardous Materials) would provide overall project safety guidance. This handbook establishes the basic safety rules and contains additional direction (sections 22.1 and 61.32b, and 61.7) to ensure proper storage, transportation, disposal, and handling of pesticides.
5. The MSDS will be posted at storage facilities and in vehicles, and made available to workers. These provide physical and chemical data, fire or reactivity data, specific health hazard information, spill or leak procedures, instructions for worker hygiene, and special precautions.
6. Herbicides will be applied within the prescribed environmental conditions described on the label. This includes considerations of wind speed (apply only when less than 10-miles per hour), relative humidity, air temperature, chemical persistence, and time since last rainfall when determining application timing.
7. Applicable laws, including the labeling instructions of the Environmental Protection Agency (EPA) and licensing requirements of the Washington State Department of Agriculture will be followed. All applicators will have attended Pesticide Applicator or Public Consultant Licensing Training. Training and testing of applicators covers laws and safety, protection of the environment, handling and disposal, pesticide formulations and application methods, calibration of devices, use of labels and data sheets, first aid, and symptoms of pesticide exposure.

8. The lowest effective concentration of the herbicides picloram or glyphosate will be used to minimize damage to non-target vegetation.
9. Herbicides will be used under the supervision of licensed personnel according to the manufacturer label.
10. In areas that are 10 to 50-feet from wetted stream edges and areas with sandy soil and a high water table, the herbicide glyphosate will be used. Picloram is not to be applied where soils have rapid to very rapid permeability (such as loamy sand to sand) and the water table is shallow, or where soils have severely fractured surfaces, and substrates that would allow direct introduction to groundwater.
11. Herbicides will contain a colored dye.
12. Herbicide application workers will be informed of known potential human health impacts from the herbicides to be used and provided copies of the relevant methods and information profiles. Workers not wishing to be exposed to glyphosate or picloram will be given alternate work assignments.
13. Where practical and effective, pre-mixed herbicide formulations and exposure-reducing equipment will be used. Herbicide formulations that contain only inert ingredients recognized generally safe by EPA, or are of a low priority for testing by EPA, will be used.
14. Personal protective equipment (PPE) such as gloves, long-sleeved shirts, boots, and safety glasses will be worn by all workers involved in herbicide mixing, loading, and backpack applications. Where specific items of protective clothing are optional, they must be on the work site at all times during application. Workers will wear a clean set of clothes daily, and should have a complete change of clothes available at the work site in case of accidental exposure.
15. An emergency eyewash unit and other washing facilities with an adequate supply of soap and uncontaminated water will be available at each work site.
16. Informational signs for herbicide spray will notify people entering the treatment area at trailheads, boat landings, and campsites.
17. Before herbicide application, persons in Chelan County who are registered as a "pesticide-sensitive" with the Washington State Department of Agriculture will be notified. Applicators spraying herbicides shall notify the sensitive individuals at least two hours prior to the scheduled application. This applies when making applications to properties adjacent to the

properties of pesticide-sensitive people. Workers who know that they are hypersensitive to herbicides will not be used in application projects. Workers who display symptoms of hypersensitivity to herbicides during application will be removed from the project.

18. Adjacent landowners who could be directly affected by chemical drift, stream transport, or an accidental spill, will be notified (normally 15-days) prior to the chemical application. The MSDS will be available to interested or affected individuals on request.
19. Precautions will be taken to assure that equipment used for storage, transport, mixing, or application of herbicides will not leak (see separate spill plan in **Appendix B**). Areas used for mixing herbicides and cleaning equipment will be located outside riparian areas, in locations where spillage will not run into surface waters or result in groundwater contamination.
20. All things considered, if herbicide use is indicated for crupina located within 10-50 feet either side of the wetted perimeter of ephemeral or intermittent streams glyphosate will be applied with low-pressure hand equipment or wicking.
21. Buffers will be established along areas of concern, such as streams and sensitive plant locations. Where areas of concern exist, the appropriate specialist will assist in project implementation to ensure resources protection. Local conditions could require adjustment of the buffer based on topography, soil, weather, non-adverse impacts to non-target organisms and water quality, or other site-specific conditions. Herbicides will not be applied within 10-feet of the wetted perimeter of streams. Buffers will reduce drift into surface water, reduce the risk of subsurface leaching and mobilization due to a rising water table, and minimize introduction of chemicals into ephemeral streams.
22. No herbicides will be used within 100-feet of the Swartz property or water source.

General

1. During implementation of crupina treatments there will be no helicopter use on weekends and Federal holidays.
2. Use of helicopters to stage water for use in mixing herbicide formulations will be scheduled to minimize disturbance (not all day long, every day).

3. Utilize existing helispots. Locate staging areas and other centers for mechanized transport 300-feet away from water. Prohibit helicopter fueling and fuel storage in project area.
4. During implementation of crupina treatments there will be no use of motorized pumps within 400-feet of the Lakeshore Trail on weekends and Federal holidays.
5. Informational signs for crupina treatment operations will notify people entering the treatment area at trailheads, boat landings, and campsites
6. Except in designated camps in the project area, overnight camping with livestock along the Lakeshore Trail will be prohibited by issuing a CFR closure order until annual crupina treatment is completed. Other closures will be considered for public safety during project operations.
7. For mechanical crupina treatment with radiant heat disks, applicators will be instructed in listening and smelling for potential gas leaks and avoiding direct contact with the heating element by keeping the torch pointed at the ground. To minimize the risk of falls over uneven ground, applicators will be required to carry propane tanks and application wands securely. To reduce the risk of fire in dry vegetation, use of radiant heat disks will occur early in the treatment window or at locations where crupina is not accompanied by a lot of other accumulated dry vegetation.
8. Workers implementing crupina treatments will have a crew size limited to a maximum of 21-persons per location. This is consistent with the Forest Plan administrative restrictions on party size which use the word "should" rather than "shall" or "will".
9. The recreational stock allotment in the project area will continue in "non-use" status.
10. Crupina treatments will be coordinated with adjacent landowners with advance approval for adjacent private land as applicable.
11. Information and experience gained from each year of crupina treatment would be reviewed by the Project Coordinator and used to refine future treatments with methods covered in this EIS (the essence of adaptive management) with a goal of improving effectiveness and reducing impacts.
12. Prior to implementation of manual, radiant heat disk, or cultural crupina treatments, workers will be given site specific safety instructions, personal protective equipment (PPE) such as gloves, long-sleeved shirts, boots,

and safety glasses. These measures, in conjunction with personal hygiene, would prevent injuries or irritations.

13. For safety reasons, locations (mainly near rock out-crops areas) suspected to have a high potential for rattlesnake habitat would be left untreated.

Vegetation

1. To prevent impacts to ephemeral biota such as fungi and mollusks, aspen and big leaf maple stands (areas with hardwood leaf litter) will not be treated with herbicides. This will also prevent impacts to important forage for the western gray squirrel.
2. Cultural (seeding) treatments will use weed-free certified seed.
3. Hand-pulling workers will be trained to identify sensitive plants.
4. For areas with known TES and monitor plant sites crupina treatments (all methods) will not be implemented until the plants have grown or are developed sufficiently to be identifiable and flagged by the District botanist.
5. Sensitive plants will be flagged (all treatment methods) by the District botanist prior to crupina treatments. Only hand-pulling treatments will be implemented within 25-feet of sensitive plants.
6. If previously undiscovered PETS or Survey and Manage plants are found within the crupina treatment areas, work will be halted until the District botanist is consulted and necessary mitigation measures are implemented.
7. Where feasible, field crews will travel to crupina treatment area locations along existing trails and will avoid creating new, visible trails.
8. Follow-up monitoring and treatments will be coordinated to maximize treatment method effectiveness and overall project efficiency.

Wildlife

1. To avoid creating bear/human conflicts, the following camp sanitation guidelines will be implemented:
 - Store food and garbage in secure containers.
 - Separate cooking/food storage and sleeping areas.
 - Remove garbage regularly from camp sites.
 - Food and garbage will not be left unattended.
 - Follow "pack it out" policy with all lunch refuse.
 - Remove all food and garbage from campsites following completion of project activities for the season.

Heritage Resources

1. Annually, crupina proposed treatment locations will be compared with documented heritage resource locations and avoidance or protection measures will be discussed with a Forest Archaeologist. This will be documented in an addendum to the original heritage resource survey report. The findings will also be submitted to the Forest Heritage Program Manager and the State Historic Preservation Office for review.
2. If undocumented and potentially eligible heritage resources are discovered that cannot be protected through avoidance or project design, the Forest Heritage Program Manager, tribal governments, and the State Historic Preservation Officer will be consulted. Mitigation will be prescribed prior to weed treatment.

2.1.4 Other Alternatives Considered but Eliminated from Detailed Analysis The following section describes other proposals considered and dismissed from further analysis.

1. Crupina treatment using prescribed fire. Although use of fire was previously considered as a crupina treatment method, recent fires (Fish 1990, Pioneer 1998, and Rex 2001) demonstrate that burned areas support higher post-fire densities of crupina due to reduction of canopy cover and decreased competition from other vegetation. Areas within the Fish Creek fire area, for example, support some of the densest populations of crupina. The Pioneer Creek fire area burned when fuel moisture was low and duff/crupina seed consumption was maximized. The area burned again with the Rex Creek fire in 2001, under more extreme (dry) conditions. After the burns, just three years apart, crupina seedlings were sprouting a few weeks after the second fire was controlled.
2. Crupina treatment using a helicopter to spray herbicides. Although aerial application would facilitate treatment of steep, remote terrain, it was not analyzed in detail because it would have more potential to affect non-target native vegetation, disrupt ecosystem function, and affect wilderness resources.
3. Crupina treatment using biological controls. This alternative was not further evaluated due to a lack of known biological controls specific to crupina.
4. Proposed crupina treatment with no follow-up cultural treatment. This alternative was considered and not further analyzed since it would not meet the purpose and need of the project. Some areas lack native vegetation to re-colonize infested sites. Without seeding or planting, it is likely that crupina or other weeds would invade.

5. Use of non-native, non-persistent seed for cultural treatments was not further evaluated. Since seeding would occur primarily where native vegetation is lacking, use of non-native, non-persistent seed would not give protection from invasion by crupina or other new weeds. Seeding with natives or native cultivars is preferred to get persistent desirable species into disturbed areas. Native cultivars are in the area from restoration work done after the Rex Creek wildfire.
6. Other mechanical treatment methods such as disking, cultivation, or other tillage practices were not considered further due to potential soil impacts, lack of road access, and terrain limitations.
7. Herbicides other than glyphosate and picloram known to treat crupina include dicamba, 2,4-D amine, Escort® (metsulfuron), and Telar® (clorsulfuron). Dicamba was not analyzed further because research indicates that the most effective treatment with this herbicide requires warm, dry weather during and after application. These weather conditions are not frequent during spring in the Lake Chelan area. Delaying treatment until the weather warms increases the risk of injury to non-target vegetation and might be too late to prevent seed production. The same limitation was found with a mixture of 2,4-D amine and dicamba (Prather *et. al.*, 1991). The herbicides Escort® and Telar® have been used on crupina with some success. The difference between these herbicides and picloram is the lack of residual activity (John Cantlon, personal communication, 2003). Both Escort® and Telar® have residual effects that last about 20-days as opposed to longer periods for picloram. The lower level of residual activity would necessitate more frequent herbicide application and would not increase treatment effectiveness. In addition, neither of these herbicides is suited for use near water like glyphosate. Both Escort® and Telar® were not considered further due to a lack of residual activity and the lack of suitability for use near water. Transline® and other herbicides were not analyzed since there is no current research that indicates effectiveness on crupina.

Section 2.2 Monitoring

Monitoring is planned as an integral part of the overall vegetation management project. The monitoring items in **Table 2-2** (page 2-15) will be conducted if any of the action-alternatives are implemented. This monitoring is designed to verify that the projects are implemented as designed, and are effective and efficient in meeting project and Forest Plan objectives. Water quality monitoring will be conducted as described on the Region 6 Water Quality Monitoring Guide for Pesticide Detection (R6-WS-040-1980). Monitoring will be conducted to determine if impact avoidance measures are being observed, are effective in maintaining water quality, and are in compliance with state water quality standards and pesticide label requirements.

Table 2-2. Monitoring Plan for Action Alternatives

WHAT	WHY	HOW	WHERE	WHEN	WHO
Crupina presence and density	Determine effectiveness of treatment methods	Visual inspection, compare known infestation areas with post-treatment areas	Random over project area, emphasis at trailheads, boat landings, and campsites	Post-treatment	Project Coordinator
Sensitive plant populations	Determine effect of weed treatments on sensitive plants	Visual inspection	Treatment areas near known sensitive plant sites	Flag and buffer before treatment & for 2 growing seasons after treatment	Botanist
Weed treatment techniques	Determine effectiveness of treatment methods	Visual inspection, compare known infestation with post-treatment area	Random over project area, emphasis at trailheads, boat landings, and campsites	Post-treatment	Project Coordinator
Non-target plant species	Determine effect of weed control on non-target plants	Visual inspection	Random over project area, emphasis at trailheads, boat landings, and campsites	Post-treatment	Project Coordinator
Weather conditions	Determine compliance with herbicide label.	Measure wind, temperature, and humidity	Representative locations for planned herbicide treatment	Pre-treatment	Project Coordinator
Water quality	Determine herbicide drift	Observe dye from herbicide. Collect water sample	Rattlesnake Creek	Immediately after herbicide application	Hydrologist
Follow-up cultural (seeding) treatment	Limit soil disturbance, limit re-invasion of crupina or other weeds	Visual inspection	Treatment areas, especially where native vegetation is ≤25% of total cover	Post-treatment	Botanist
Review information and experience gained from each year of crupina treatment	To implement adaptive management strategy	Annual review of project activity and results	Annual treatment areas	Annually, post-treatment	Project Coordinator
Worker and public exposure to herbicides.	To ensure worker and public safety	Follow herbicide label; document on form FS-2100-5	Herbicide treatment areas	Following herbicide application	Project Coordinator

Section 2.3 – Alternative Comparison

This section provides a cursory comparison of the alternatives, and a synopsis of issue related environmental consequences for the key issues. The intent is to highlight the differences between the alternatives and between the effects the alternatives have on the issues. For more detail, see specific resource discussions in Chapter 3. **Table 2-3** presents a snapshot of the key features of all alternatives.

Section 2.4 – The Forest Service Preferred Alternative

Alternative C (Proposed Action) is the Forest Service preferred alternative. This alternative would implement integrated weed management activities while maintaining other resource characteristics. At this time, the Proposed Action represents the best recommendation for containment, control, and eventual eradication of crupina. It is designed to achieve the objectives discussed in Section 1.3, The Purpose and Need for the Proposed Action.

Table 2-3. Comparison of Alternatives.

Issues	Alternatives			
	A No Action	B Hand-pull only	C Proposed Action	D No Motorized Equipment or Mechanized Transport in Wilderness
Acres of annual weed treatment by method.				
Hand-pull	None	100-acre max	100-acre max hand-pull and heat disk;	100-acre max hand-pull and heat disk
Radiant heat disk		none	100-acre max	50-acre max
Herbicide		none		
Total annual weed treatments (all methods).	None	100	200	150
Annual wilderness weed treatment acres.	None	Up to 100	Up to 200	10
Implementation of integrated weed management.	No	No	Yes	Yes
Restore native vegetation and biodiversity (ecosystem integrity).	No	Limited	More likely due to more treated acres than B or D	Limited, though more acres than B
Likely to limit the spread of crupina, leading to control and eventual eradication.	No	To date, spread limited but no control or eradication	Yes, most likely to control or eradicate	Yes, spread limited, fewer acres than B
Potential effects on resources from herbicides	No	No herbicides used	Yes, but mitigation measures applied	Yes, fewer acres than C
Potential effects on human health from herbicides.	No	No herbicides used	Yes, minimal and below reference dose levels (RfDs) of toxicity	Yes, minimal with less acreage than C; toxicity levels below reference doses
Potential to exceed herbicide RfDs (reference doses).	No	No	No	No
Includes use of motorized equipment (pumps) and mechanical transport (helicopters) in wilderness.	No	No	Yes, mitigation would limit use	No

Issues	Alternatives			
	A No Action	B Hand-pull only	C Proposed Action	D No Motorized Equipment or Mechanized Transport in Wilderness
Wilderness integrity compromised.	Yes, no trend to restore	Yes, current condition maintained	Yes, with trend to restore	Yes, trend to restore on fewer acres than B
Weed treatment consistent with wilderness standards and guidelines.	Yes	Yes	Yes	Yes
Potential private land weed treatments.	No	Yes	Yes	Yes
Weed treatment workers (total worker-days).	None	40 (1,920)	50 (2,240)	50 (2,080)
Potential disturbance to wildlife security/core habitat from motorized equipment and weed treatment workers.	No	Yes	Yes	Yes
Effects of crupina treatments on shrub steppe habitat (mule deer winter and spring range, grizzly bear spring emergence habitat, bald eagle winter/spring foraging habitat).	None	Yes, short-term restoration, long-term current conditions maintained	Yes, more likely with more acres than B or D, with trend to long-term restoration	Yes, trend to long-term restoration on fewer acres than B
Herbicide application in accordance with Forest Service Manual 2150 (Pesticide-Use Management and Coordination).	N/A	N/A	Yes	Yes
Herbicide application in accordance with Forest Service Handbook 2109.14 (Pesticide-Use Management and Coordination Handbook).	N/A	N/A	Yes	Yes
All crupina treatments consistent with the Okanogan and Wenatchee National Forests Hazard Communication Program and Forest Service Handbook 6709.11 (Health and Safety Code Handbook).	N/A	Yes	Yes	Yes

Chapter 3

Affected Environment and Environmental Consequences

Chapter 3 changes between the Draft and Final Environmental Impact Statements:

The Wildlife and Wilderness Environmental Consequences sections were revised to account for the change in party size limitations. The Wildlife section includes analysis indicating fewer impacts to wildlife from two larger parties as opposed to 3 or 4 smaller parties. The Wilderness section includes analysis of the larger party size on wilderness experience.

Other changes in Chapter 3 are minor clarifications as a result of comments on the DEIS (see **Appendix J**, Agency Letters and Response to Comments and **Appendix K**, Response to Public Comments).

Chapter

3

Affected Environment and Environmental Effects

This chapter describes the existing condition of specific resources and the direct, indirect, and cumulative effects of alternative implementation. The affected environment against which change is measured and the effects the alternatives would have on these conditions is discussed. While all effects will be disclosed, the purpose-and-need and the key issues focus the analysis.

Specific resources are grouped into three categories: physical environment, biological environment, and human environment. For each resource, the affected environment is depicted first, followed by a discussion of direct, indirect, and cumulative environmental consequences.

Section 3.1 – The Biological Environment

This section describes the affected environment and the effects of alternative implementation on plant and animal species and associated habitats.

3.1.1 Competing and Unwanted Vegetation: Affected Environment

Noxious Weeds: *Crupina vulgaris* (crupina) is a Washington State Class A noxious weed. See **Appendix C** for Washington State noxious weed category definitions. State law requires the eradication of Class A noxious weeds. Class B noxious weeds present in the project area include *Cytisus scoparius* (Scotch broom), *Centaurea diffusa* (diffuse knapweed), *Centaurea biebersteinii* (spotted knapweed). Annually in the past, both diffuse and spotted knapweeds were hand-pulled/grubbed in campsites associated with boat docks at Prince Creek and Moore Point. Scotch broom is pulled as it is discovered on other National Forest System land. Class C weeds in the area include *Cirsium arvense* (Canada thistle) and *Convolvulus arvensis* (field bindweed). Weeds in the project area on the Washington State monitor list include *Verbascum thapsus* (common mullein).

Many non-native, undesirable plant species that are not on noxious weed lists grow along trails in the area infested with crupina. These species include: *Taraxacum officinalis* (dandelion), *Tragopogon dubius* (yellow salsify), *Erodium cicutarium* (cranes bill), *Dactylis glomerata* (orchard grass), *Cirsium vulgare* (bull thistle), *Equisetum arvense* (horse-tail fern), and *Lactuca serriola* (prickly lettuce). Non-native annual grasses, primarily *Bromus tectorum* (cheatgrass), *Poa bulbosa* (bulbous bluegrass), and *Festuca vulpia* (slender fescue) commonly grow with crupina.

Crupina Life History and Vectors for Spread (see pages 1-14 and 1-5, also):

Crupina is native to the Mediterranean region of Europe. Control of crupina is considered feasible because it has relatively slow natural dispersal, dependence on annual seed production, short seed life (32-months), grassland habitat, and susceptibility to herbicides that do not destroy grasses (Prather et. al., 1991). Crupina is a winter annual; seeds usually germinate in the fall. Plants over-winter as rosettes, bolt in the spring, and flower by June. Wind can spread seeds up to 5-feet from parent plants. Rodents can carry seed up to 50-feet, and cattle and deer can move the seeds on hooves and hair at least 300-feet from parent plants (Prather et al., 1991). Livestock and wildlife may transport ingested seed for greater distances before excretion. Humans may transport the seed in clothing or on gear (Kimberling et.al., 2003).

Treatment History: Crupina was first discovered in the project area in 1984. It is not known how or when it was first introduced. In 1988, limited sections of the Lakeshore Trail and a short section of road on private land were treated by hand-pulling. In 1989, the infested area was surveyed to determine the extent of the infestation; again the Lakeshore Trail corridor and a few patches near the trail were hand-pulled. In 1990 the range permittee for the Round Mountain grazing allotment voluntarily waived permit rights to help prevent the spread of crupina. From 1990 through 1993 hand-pulling along the Lakeshore Trail corridor was repeated, and herbicides 2, 4, D and dicamba (Banvil®) were spot-sprayed on private land. From 1994 through 2001 hand-pulling was limited to the National Forest System land along the trail corridor and some select patches. As funding decreased, hand-pulling was confined primarily to the trail corridor. Hand-pulling reduced the density of crupina along the trail and some small trailside patches were eradicated. Hand-pulling the trail corridor appears to have been successful in preventing the spread of crupina to other areas since no new plants have been discovered. However, the large, dense patches of crupina above and below the trail continued to grow in size, and increase in density.

Funding associated with the Rex Creek fire recovery effort enabled a larger hand-pulling project in the spring of 2002. Almost 1,000-worker days were used. Crews concentrated on dense areas adjacent to trails and other key locations as well as maintaining the trail corridor. Some pulling was also done on private land. Hand-pulling patches of dense crupina is time consuming; a crew of 12-workers spent 8-days pulling a two-acre patch. The window for pulling crupina is short; plants that sprout in April usually flower by June. Of the nearly 500-infested acres of crupina, about 100-acres were hand-pulled.

A second large-scale crupina hand-pulling effort occurred in the spring of 2003 with crews returning to sites that were hand-pulled in 2002. Most of the areas treated in 2002 still had at least a light level of infestation, probably because more crupina sprouted after the site was initially pulled. The density of crupina was much higher at sites not pulled in 2002 (personal communication, Roche, 2003). In some cases, bunchgrasses that were seeded in the pulled sites

appeared to be thriving. On other sites, grasses including cheatgrass and annual fescue were crowding crupina seedlings resulting in less robust plants.

Rex Creek Fire: This fire burned about 55,000-acres in 2001, including the entire crupina infestation, increasing potential crupina habitat. Portions of the Lakeshore Trail were nearly obscured by cheatgrass. Research transects through crupina infestations that were established and sampled before the fire were sampled again in 2003. Crupina infestations expanded into areas previously dominated by trees and individual crupina plants increased in vigor, both in size and seed output (personal communication, Roche, 2003). The increased sunlight reaching the ground after the trees and accumulated duff layer burned provided a favorable environment for crupina.

3.1.2 Competing and Unwanted Vegetation: Environmental Consequences

The effects of each alternative on competing and unwanted vegetation are discussed below. The geographic boundary for cumulative effects is defined as the area potentially infested with crupina. The temporal boundary for cumulative effects begins with the start of livestock grazing in the area in the early 1900s and ends ten years after the completion of this project.

The noxious weed and competing vegetation strategies designed for the Crupina IWM Project are consistent with the 1988 Record of Decision for the Final Environmental Impact Statement (FEIS) for Managing Competing and Unwanted Vegetation (USDA, Forest Service, 1988), and the associated Mediated Agreement (1989). By using these strategies, noxious weed rate of spread is not expected to increase, nor is the threat of competing vegetation. This document updates information from the 1988 FEIS with the latest scientific information.

Alternative A (No Action)

Direct and Indirect Effects: Under this alternative no crupina treatments would occur. Crupina would likely re-infest the trail corridor, increasing the likelihood of spread to other areas. Most of the dry open forest, shrub-steppe, and dry agricultural land in eastern Washington is potential crupina habitat. Idaho has over in 60,000 acres infested with crupina (Prather *et. al.*, 2003). Crupina populations at existing sites would become denser, eventually becoming the dominant plant on many sites. Sites dominated by crupina have little or no value to wildlife and would be aesthetically displeasing to trail users.

Other noxious weeds and unwanted plants would continue to occupy sites along the trail and in the campgrounds. Cheatgrass and other annual, weedy grasses would continue to occupy dry sites, often along with crupina. No weed treatment activities would take place that could potentially spread crupina or other noxious weeds.

Cumulative Effects: Past actions (see Disturbance History, page 3-7) have decreased the ability of the ecosystem to withstand an invasion of noxious weeds. Foreseeable future actions, which are also ongoing activities, include recreational use of the trail, boat landings, campsites, trail maintenance, recreational livestock grazing, weed treatment on private land, and fire suppression. Recreational livestock grazing occurs around the campsites at Prince Creek and Moore Point. If not treated, trail users and livestock would be more likely to spread crupina, possibly leading to trail closure. Fire suppression activities increase the likelihood of crupina spread from the movement of personnel through infested areas and ground-disturbing actions like fireline construction. No livestock grazing would occur, except incidental grazing along the trail and designated livestock areas near the campsites and Prince Creek and Moore Point. The past effects of livestock grazing would continue to influence vegetation. This alternative would not contribute to an adverse cumulative effect; however it would do nothing to mitigate the effects of past and future actions.

Alternative B (Only Hand-pulling Method Used)

Direct and Indirect Effects: Hand-pulling is an effective method of killing individual crupina plants. Crupina is easy to pull because it is an annual plant without an extensive root system. Hand-pulling dense patches of crupina, however, is time-consuming. In 2002, it took a 12-person crew eight days to pull a two-acre patch of dense crupina. Rex Creek fire recovery funds enabled a large hand-pulling effort in 2002. After 1,000-person days of work about 100-acres of the 500-acre infestation was treated. Because this level of funding was tied to short-term fire recovery efforts, the 2002 funding level is not likely to be available in the future.

Due to a short growing season, steep terrain, the density of some patches, and the remote location, even with adequate funding it would be unlikely that the entire area with crupina infestations could be pulled in a single season. Crupina plants flower and go to seed by mid-June, so pulling must take place between mid-March and June. Hand-pulling crupina in the rosette stage (March and April) requires crews to work on hands and knees. Crews must hike to all the sites away from the lakeshore; there are no roads in the project area. Because the project area is more than 30-miles up-lake reached only by boat, crews must camp. These logistical challenges increase the cost of hand-pulling efforts.

Hand-pulling the trail corridor would help prevent crupina spread to other areas however these sites would constantly be re-infested from other populations up- or down-slope. Crews would have to pull the same areas each year without moving on to other populations. Populations not treated would become denser, providing more seed for invasion of pulled sites. As the off-trail patches grow larger and denser the likelihood that crupina seeds would spread down-lake or across the ridge into Okanogan County would increase.

Hand-pulling crupina would disturb soil, creating conditions favorable to other weeds, especially annual grasses. Areas with soil disturbance would be seeded with native bunchgrass and/or yarrow to compete with other undesirable plants. Chelan Ranger District personnel collected and propagated native blue bunch wheatgrass and yarrow seed. This would be used as quantities last. The use of local, native seed would not have an adverse effect on the native vegetation and may prevent the invasion of other weed species. After the Rex Creek fire crupina habitat was seeded with a mix of native cultivars. Since these cultivars are already present throughout the area their use would have no adverse effects if native local seed is depleted.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct and Indirect Effects: Alternative C would treat crupina using a combination of hand-pulling, radiant heat, seeding, and herbicides. The effectiveness of hand-pulling activities has been discussed under Alternative B. Radiant heat disks kill weeds by heating plant tissue to the point of cellular breakdown, and are most effective on young plants. The disks are about 4-inches wide and are powered by back-pack mounted propane tanks. Crupina seedlings are small and relatively vulnerable to heat treatment. Heat treatment is less effective on older plants. Heat disks would not be used near sensitive plant populations or where the crupina is surrounded by dead and dry vegetation, such as cheatgrass due to the risk of starting a fire.

Crupina plants are easily killed by low concentrations of herbicide. For areas with a low cover of native plants herbicide use would be indicated. In most areas, the herbicide picloram would be used. The use of picloram would capture more delayed germinants due to residual effects. This would allow a progression of containment, control, and eradication of crupina. For areas that are 10-50 feet from water the herbicide glyphosate would be used. Herbicides would be spot-sprayed or hand-wicked. The use of herbicide in the project area would present some logistical challenges since there are no roads and no easy sources of water. This alternative would allow the use of motorized equipment and mechanical transport in wilderness. Water would be pumped out of the lake and stored in holding containers at mixing sites away from the lake. Helicopters would be used to stage water in areas farther from the lake. It would not be possible to treat all infested areas with herbicide, due to steep and rocky terrain.

Use of all the possible weed treatment methods would allow the most acres to be treated during the treatment window. Hand-pulling would be used in sensitive sites, areas within 10-feet of water, in outlying sites with lower crupina densities, and areas with a high cover of native plants. In areas that are relatively easy to access, radiant heat disks would be used on sites with dense crupina with no fire hazard concerns, and herbicides would be used on sites with dense crupina and a low native plant cover (see Crupina Treatment Method Criteria, page 2-6).

Hand-pulling, heat disk, and herbicide treatments would all cause some soil disturbance. The removal of crupina plants would leave voids for other weeds like cheatgrass and bulbous bluegrass to invade. Treated areas would be seeded with native bunchgrass and/or yarrow to compete with crupina and other weeds that could invade the site. Chelan Ranger District personnel collected and propagated native blue bunch wheatgrass and yarrow. This native seed would be used as quantities last. The use of local, native seed would not have an adverse effect on the native vegetation and may prevent the invasion of other weed species. After the Rex Creek fire crupina habitat was seeded with a mix of native cultivars, so these cultivars are already present throughout the area and their use would have no adverse effects if the supply of native seed were depleted.

By combining treatment methods this alternative would allow maximum flexibility to deal with varied conditions, improve treatment effectiveness, and maximize the number of acres that could be treated in any given year. This would offer the best chance for crews to treat crupina populations that were not treated in the past and to prevent crupina spreading to new sites.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Motorized Equipment or Mechanical Transport in Wilderness)

Direct and Indirect Effects: This alternative, like Alternative C, would allow a combination of weed treatment methods. The effects of hand-pulling, seeding, and use of the heat disk would be the same as in Alternative C. In this alternative, however, no support of motorized equipment or mechanical transport would be allowed in wilderness. There would be no pumps to get water out of the lake and no use of helicopters to stage water and equipment. The lack of logistical support would limit the number of acres of National Forest System land that could be treated with herbicide. Private land, which has boat access, could still be treated with herbicide. About 50-acres of crupina would be treated with herbicide each year.

Dense patches of crupina that are not on or near private land or boat access points would have to be hand-pulled or treated with the heat disk (if conditions allow). Hand-pulling dense patches of crupina is time-consuming and expensive. Fewer total acres of crupina would be treated in a season, and overall, than in Alternative C. Alternative D would help prevent the spread of crupina into new sites and would allow more total acres to be treated in a year than Alternative B, but would not be as effective compared to Alternative C. More acres would remain untreated under this alternative. Untreated areas would continue to increase in density, increasing the risk of spread to other sites.

Cumulative Effects for All Action Alternatives

Past actions and foreseeable future actions are the same as in Alternative A. Foreseeable wildfires could spread crupina from areas not treated. With priority treatment given to the Lakeshore Trail, all action alternatives are likely to prevent crupina spread from this area. The action alternatives would not contribute to an adverse cumulative effect to competing and unwanted vegetation. The control of crupina would help native plant communities recover from past actions. Mitigations designed to protect native plants when they are present, and to re-vegetate areas disturbed by weed treatments, will help prevent the action alternatives from resulting in an increase in weeds in the project area.

3.1.3 Native Vegetation: Affected Environment

The crupina infestation along the north shore of Lake Chelan occurs in shrub-steppe/grassland communities and open ponderosa pine and Douglas-fir forests. On less disturbed sites native bunchgrasses such as *Pseudoroegnaria spicata* (blue bunch wheatgrass), and native herbaceous species such as *Balsamorhiza sagittata* (arrowleaf balsamroot) and *Lupinus sericeus* (silky lupine) dominate the understory. Shrubs include *Purshia tridentata* (bitterbrush) and *Sambucus cerulea* (blue elderberry). Early spring native plants that emerge with crupina include *Lithophragma parviflora* (prairie star), *Collinsia parviflora* (small-flowered blue-eyed Mary), *Montia parvifolia* (small-leaved montia), *Viola tricornata* (sagebrush violet), *Lomatium geyeri* (Geyer's lomatium), and *Zigadenus venenosus* (death camas).

Many non-native plant species grow along trails in the area infested with crupina. These species include: *Taraxacum officinalis*, *Tragopogon dubius*, *Verbascum thapsus*, *Erodium cicutarium*, *Dactylis glomerata* (orchard grass), *Cirsium vulgare*, *Equisetum arvense*, and *Lactuca serriola*. Non-native annual grasses, primarily *Bromus tectorum* (cheatgrass), *Festuca vulpia* (slender fescue), and *Poa bulbosa* (bulbous bluegrass) dominate disturbed sites.

Disturbance History

Grazing: Beginning around 1905 much of the Chelan basin was grazed by cattle and sheep. Grazing was minimal until 1916-1922 when sheep were barged to remote areas in part to support World War I. During this time, the number of sheep dramatically increased. According to records in the 1917 Chelan Leader newspaper, a barge moved 75,000-sheep up and down the lake. Due to steep terrain and limited accessibility along much of the shoreline, barged sheep were released primarily at two project area locations, Meadow Creek and Moore Point. From these locations sheep were grazed up valleys to upper basins.

The Round Mountain grazing allotment, established in 1937, received heavy winter use by horses from Stehekin and Lucerne as well as summer use by both cattle and horses. Winter grazing was hard on range plants; cheatgrass invasion may be associated with this use. General concern about the effects of sheep

grazing on watersheds all over the west led to a decrease in sheep grazing in the 1930s. Some level of local sheep grazing continued, however, until 1999 when the permit was waived. Since 1970 the allotment has been used for horses. From 1986 to 1991 permitted use ranged from 10 to 25 horses. Since 1991, there has been a moratorium on grazing in this allotment due to the crupina infestation.

Early grazing was not well regulated. The relatively high level of grazing from 1916 until 1925 favored the increase of tree seedlings on south facing slopes as well as the reduction of native shrubs, forbs, and deep-rooted perennial grasses. The reduction of perennial grasses left voids now occupied by noxious weeds. Additionally, intensive grazing combined with fire suppression resulted in a loss of riparian area structure. Tall shrubs such as willow and alder replaced low shrubs, perennial grasses, and forbs.

Fire: Until the establishment of the smoke jumper base in the nearby Methow Valley, fire suppression efforts were not as effective in the project area due to difficult access. After smoke jumper and rappel programs were established in 1950s and 1970s respectively, fire suppression efforts became more successful. The following fifty years of fire suppression influenced the vegetation. Lower elevation dry forests and shrub steppe burned with greater frequency and lower intensity prior to European-American settlement; fire frequency ranged from 4 to 14 years. The low intensity fires resulted in fewer and younger shrubs, less Douglas-fir, and larger fire-resistant ponderosa pine. Overall shrub cover increased with fire exclusion but individual shrubs became decadent. Portions of the project area burned in the Cascade Creek fire (1985), Fish Creek fire (1990), Prince Creek fire (1998), and the 1998 Pioneer Creek fire. In 2001, the Rex Creek fire burned the entire area infested with crupina as well as adjacent potential habitat.

3.1.4 Native Vegetation: Environmental Consequences

The effects of each alternative on native vegetation are discussed below. The geographic boundary for cumulative effects documentation is the area potentially infested with crupina. Cumulative effects are examined for the period between 1905, the estimated initial grazing of livestock in the area, and ten years from the completion of this document, when proposed activities would be completed.

Alternative A (No Action)

Direct and Indirect Effects: Native plants, especially annuals, would continue to be threatened by crupina. Crupina is more successful than native plants in occupying habitat by germinating in fall and winter and taking advantage of early spring moisture before native plants are actively growing. Crupina populations would continue to increase in size and density. Crupina would eventually spread outside of the analysis area, transported by people who use infested trails or wildlife. All dry, open forest and shrub steppe east of the Cascades is vulnerable

to crupina invasion. Crupina currently occupies over 60,000 acres of dry land in Idaho (Prather et. al., 2003). Land that has been or is being heavily grazed by livestock would be especially vulnerable. Heavy livestock grazing reduces the vigor and cover of native plants. In some areas native plants could be completely replaced by crupina, reducing the diversity of native vegetation and wildlife and livestock forage.

Cumulative effects: Past actions (see Disturbance History, page 3-7) decreased the ability of native plant communities to withstand invasion of noxious weeds. Past weed treatments, which were concentrated along the lakeshore trail, appear to have prevented the spread of crupina to new areas, although they did not substantially reduce the total infestation. Ongoing and foreseeable future actions include use of trails, developed sites, and boat docks, trail maintenance, recreational livestock grazing, fire suppression, and weed treatments on private land. All of these activities have potential to spread crupina. Fire suppression activities increase the likelihood of crupina spread from movement of personnel through infested areas, and ground-disturbing actions like fireline construction. Weed treatment on private land could help prevent spread of weeds to National Forest System land. Taking no action under this alternative would not contribute adverse effects to native vegetation however it would do nothing to alleviate the effects of past, present, and foreseeable future actions.

Alternative B (Only Hand-pulling Used)

Direct and Indirect Effects: All native plants would benefit from hand-pulling of crupina. The use of only hand-pulling would avoid the risk of non-target plant injury or death from herbicide drift. However, there would be some trampling and soil disturbance associated with hand-pulling efforts. Trampling could result in the death of or damage to native plants. Annual plants would be the most vulnerable. Sites pulled in the spring of 2002 were revisited in August of that year. No noticeable mortality of native plants in pulled sites was noted.

In terms of cultural treatments (seeding) following weed treatment (page 2-5, and **Table 2-1** on page 2-6) the use of local, native seed would not have an adverse effect on the native vegetation and may prevent the invasion of other weed species. Because native cultivars are already present in the project area no adverse effects to native vegetation are expected.

The use of hand-pulling limits the number of acres treated in a given year. It is time consuming to pull large, dense patches of crupina and the treatment window is between late March and early June. About 100-acres were hand-pulled in 2002 and 2003, with higher funding due to Rex Creek fire restoration. Given logistical, wilderness, and funding considerations it is unlikely that more than 100-acres could be pulled in any year. Therefore, hand-pulling would only allow 15-20% of the total infestation to be treated each year. Because hand-pulling would target high use areas and the trail corridor this alternative would help

prevent spread to new areas. However, the crupina infestations that are not treated would continue to increase in density, decreasing plant diversity and the quality of the native plant community, and increasing the risk of spread.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct and Indirect Effects: Alternative C proposes a combination of herbicide, hand-pulling, radiant heat disk, and follow-up seeding treatments. Native plants could be accidentally killed or damaged by herbicide spray drift. To minimize damage to native plants, herbicides would be hand-wicked or spot-sprayed with a backpack sprayer. Because healthy native plants, especially perennials, are one of the best defenses against crupina invasion, herbicides would be used only where native plant cover is low to reduce adverse affects to native plant populations.

In most areas, the herbicide picloram would be used. For areas that are 10-50 feet from water, the herbicide glyphosate would be used. Picloram is a selective herbicide that kills only broadleaf plants. Grasses and trees are not damaged by picloram, though annual native broadleaf plants could be killed if accidentally sprayed. Glyphosate is less selective, but at the low rate used on crupina it is unlikely to kill perennial grasses, perennial broadleaves, trees, or shrubs. Annual plants, both grasses and broadleaves, which receive non-target spray, would be killed or damaged by glyphosate. Unsprayed areas would be seed sources for re-colonization of native plants.

The effects of hand-pulling and seeding would be the same as Alternative B.

Radiant heat disk kills weeds by heating plant tissue to the point of cellular break down. The plants usually wither instead of burning. The heat disk is about 4-inches in diameter, fueled by a backpack-mounted propane tank. Radiant heat treatments are not selective; any plant exposed to the disk could be killed or damaged. Native annual plants would be the most vulnerable to accidental damage from the heat disk.

Alternative C would allow the maximum acres of crupina to be treated in a season: up to 100-acres of herbicide spraying, and 100-acres of combined hand-pulling and radiant heat disk treatments. The combination of herbicide and radiant heat disk use in sites with dense crupina infestations and low native plant cover, and hand-pulling in less dense sites, sensitive sites, and areas with higher densities of native plants would maximize treatment efficiency and benefit native plants. Alternative C would help prevent the spread of crupina to new sites and would enable crews to begin work on infestations not pulled in previous years.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Motorized Equipment or Mechanical Transport in Wilderness)

Direct and Indirect Effects: Alternative D, like Alternative C, includes a combination of treatment methods. Alternative D would not allow mechanized use in the wilderness. Up to about 50-acres would be treated with herbicide in this alternative compared to up to 100-acres in Alternative C. Without mechanized support it would be possible to use herbicides on areas close to boat access points, private land, and areas adjacent to private land. Effects to native plants from herbicide would be the same as in Alternative C. The levels of hand-pulling and radiant heat disk use (up to a maximum of about 100-acres) would be the same as in Alternative C and have the same effects.

If conditions allow, dense patches of crupina that are not on or near private land or boat landings would have to be hand-pulled or treated with the heat disk. Hand-pulling dense patches of crupina is time-consuming and expensive. Fewer total acres of crupina would be treated in a season than in Alternative C. Alternative D would help prevent the spread of crupina to new sites and would allow more acres to be treated in a year than Alternative B, but less than Alternative C. Areas not treated would continue to increase in density, increasing the risk of spread from those sites.

Cumulative Effects for All Action Alternatives (B, C, or D)

Past, ongoing, and foreseeable actions are the same as in the Alternative A discussion. Past actions helped create conditions that favored the invasion of noxious weeds. The action alternatives would not contribute adverse cumulative effects to native plants. The mitigation measures and seeding of disturbed soil would improve conditions resulting from past actions by reducing crupina infestations.

3.1.5 Sensitive Plants: Affected Environment

The Wenatchee portion of the Okanogan and Wenatchee National Forests has 54 threatened, endangered (and proposed), and sensitive (TES) plant species that are documented or suspected to occur. Of these, 49 species could occur on the Chelan Ranger District, and potential habitat for 31 species is within the crupina project area. **Table 3-1** (pages 3-13 through 3-15) lists sensitive plants with potential project area habitat. A listing of TES plants that could occur, or have the potential to occur, on the Chelan Ranger District is in **Appendix D**.

Two TES species, both sensitive, are known to occur in the project area: *Pellaea brachyptera* (Sierra cliff-brake) and *Spiranthes porrifolia* (western ladies tresses). *P. brachyptera* is currently abundant in scattered sites along 10-miles of the lake shore. Crupina infests many of the sites. *P. brachyptera* is a deep rooted perennial that prefers rocky outcrops. Crupina also may occur in rock outcrops,

but generally not at densities high enough to directly compete with the perennial *P. brachyptera*. Of the two known populations of *S. porrifolia*, one is infested with crupina. Crupina infestation was one of the factors thought to contribute to a decline in numbers of *S. porrifolia* between 1984 and 1990 (Arnett and Gamon, 1990).

Githopsis specularioides (common blue-cup) and *Epipactis gigantea* (giant helleborine), both formerly listed as sensitive and now considered monitor species, occur in the project area. At least one *G. specularioides* site is currently infested with crupina. Because both crupina and *G. specularioides* are annuals it is likely they are in direct competition where together. The *E. gigantea* sites are not currently infested with crupina and are not adjacent to any crupina-infested areas. Until the Rex Creek fire forested areas separated crupina infestations from *E. gigantea* sites. The fire burned much of that area, creating more potential crupina habitat near *E. gigantea* sites.

Silene seeleyi (Seeley's silene), a U.S. Fish and Wildlife Service species of concern, is found on the south side of the lake, across from the project area.

Several field surveys for sensitive plants have been completed in the project area. Arnett and Alverson surveyed the area in 1984 and 1985 as part of a floristic reconnaissance of the Lake Chelan-Sawtooth Wilderness Area. The sensitive plant populations located by Arnett and Alverson have been visited by both Washington Natural Heritage Program and Chelan Ranger District Employees over the last nineteen years. Additional surveys have been conducted as part of Forest Service crupina mapping efforts and Chelan County Public Utility District (PUD) botanical surveys of the Lake Chelan shoreline. The most recent surveys were in the spring and summer of 2002. No new TES plant populations were located. Populations of *P. brachyptera* were re-located and are being monitored.

3.1.6 Sensitive Plants: Environmental Consequences

The effects of each alternative on TES plant species are discussed below. The geographic boundary for cumulative effects is defined as the area potentially infested with crupina. Cumulative effects are examined for the period between the estimated time of initial grazing by livestock grazing in the area (1905) and ten years from the completion of this document.

Table 3-1. TES plants which are known to occur, or have the potential to occur, in the project area.

Species	Category	Habitat	Potential habitat present in project area?	Documented in project area?
<i>Agoseris elata</i>	RF-S	Meadows, open woods, exposed, rocky ridge tops on various slope aspects, from low elevations to tree line.	Yes	No
<i>Antennaria parvifolia</i>	RF-S	Dry, open places, openings in Ponderosa pine forests, on sand and gravel substrates, often on the riparian foothills of the Columbia Basin.	Yes	No
<i>Astragalus arrectus</i>	RF-S	Grassy hillsides, sagebrush flats, river bluffs, to open pine forests.	Yes	No
<i>Botrychium lineare</i>	Proposed	Grassy slopes, streamside edges, and forest stands.	Yes	No
<i>Carex comosa</i>	RF-S	Lake margins, drainage ditches, rivulets, wet meadows, and other wet places.	Yes	No
<i>Carex hystericina</i>	RF-S	Wet depressions, creek drainages, hillside seeps. 500-2600 feet elevation.	Yes	No
<i>Carex macrochaeta</i>	RF-S	Seepage areas, around waterfalls, and other wet, open places, 600 to 3200 feet.	Yes	No
<i>Carex sychnocephala</i>	RF-S	Marsches, beaches, lake margins, and other low, wet ground.	Yes	No
<i>Cicuta bulbifera</i>	RF-S	Marsches, bogs, wet meadows, other wet areas from plains and lowlands to mountain valleys.	Yes	No
<i>Cryptogramma stelleri</i>	RF-S	Moist, shaded cliffs, ledges, and rocky slopes at mid and upper elevations in mountains	Yes	No
<i>Cypripedium fasciculatum</i>	SC	Low to upper elevations, in moist to dry, rocky, open coniferous forests. Often with ponderosa pine and Douglas fir.	Yes	No
<i>Cypripedium parviflorum</i>	RF-S	Bogs, damp, mossy woods, seeps, moist meadows.	Yes	No
<i>Delphinium viridescens</i>	SC	Moist micro sites in open coniferous forests, 1800 to 4200 feet.	Yes	No
<i>Eleocharis atropurpurea</i>	RF-S	In wet places, along lakeshores.	Yes	No

RF-S = Regional Forester Sensitive Species; T = Species listed as threatened by the US Fish and Wildlife Service

E = Species listed as endangered by the US Fish and Wildlife Service; SC = Species of concern, US Fish and Wildlife Service

Table 3-1, continued.

Species	Category	Habitat	Potential habitat present in project area?	Documented in project area?
<i>Geum rossii</i> var. <i>depressum</i>	RF-S	Rocky bluffs, rock crevices, talus slopes, and serpentine up to 8500 feet.	Yes	No
<i>Hackelia hispida</i> var. <i>disjuncta</i>	RF-S	Rocky, often unstable talus slopes, usually with little other vegetation, 600 to 1500 feet.	Yes	No
<i>Hackelia venusta</i>	SC, Proposed E	Rocky, loose, sandy slopes with ponderosa pine, 1000 and 7000 feet.	Yes	No
<i>Iliaama longisepala</i>	RF-S	Dry sagebrush steppes, and open hillsides, gravelly stream sides, open ponderosa pine and Douglas fir forests, 650 to 4000 feet.	Yes	No
<i>Mimulus suksdorffii</i>	RF-S	Dry, rocky, shallow soil in sagebrush or ponderosa pine. In association with grasses, <i>Phlox</i> , <i>Allium</i> , and <i>Eriogon</i> . Also in wetter areas, 3500 to 4000 feet.	Yes	No
<i>Nicotiana attenuata</i>	RF-S	Dry, sandy places often with sagebrush.	Yes	No
<i>Pellaea brachyptera</i>	RF-S	Dry, rocky slopes with blue bunch wheatgrass and <i>Aspidotis densa</i> , talus slopes, crevices, outcrops, sometimes in scattered ponderosa pine and Douglas fir forests.	Yes	Yes
<i>Physaria didymocarpa</i> var. <i>didymocarpa</i>	RF-S	River gravel bars, shale outcrops, rocky flats, gravelly prairies, talus slopes, dry hillsides, and road cuts (very well-drained soils with little vegetation cover).	Yes	No
<i>Saxifragopsis fragarioides</i>	RF-S	Cracks and crevices on cliffs, and in rock outcrops and talus. Near PIPO/PSME forests. Elevation 1400-4300 ft in WA.	Yes	No
<i>Sidalcea oregana</i> var. <i>calva</i>	PE	Dry forest and moist meadows, stream margins generally within ponderosa pine forests. With quaking aspen and Wenatchee larkspur in moist sites.	Yes	No
<i>Silene seelyi</i>	SC	Basalt and granite crevices on rock outcrops on vertical cliffs, usually in the absence of other species, 2000 to 7000 feet.	Yes	No

RF-S = Regional Forester Sensitive Species; T = Species listed as threatened by the U.S. Fish and Wildlife Service
E = Species listed as endangered by the U.S. Fish and Wildlife Service; SC = Species of concern, U.S. Fish and Wildlife Service

Table 3-1, continued

Species	Category	Habitat	Potential habitat present in project area?	Documented in project area?
<i>Silene spaldingii</i>	SC, WAT	Open grasslands with a minor shrub component and occasionally scattered conifers. With Idaho fescue and snowberry.	Yes	No
<i>Spiranthes diluvialis</i>	T	Seasonally flooded moist meadows, near PIPO woodlands and sagebrush steppe	Yes	No
<i>Spiranthes porrifolia</i>	RF-S	Dry to moist meadows, swampy areas, sea-level to moderate elevations in mountains	Yes	Yes
<i>Trifolium thompsonii</i>	SC	Open to lightly wooded habitat in the big sage/Sandburg's bluegrass association.	Yes	No

RF-S = Regional Forester Sensitive Species; T = Species listed as threatened by the U.S. Fish and Wildlife Service
 WA T= Species listed as threatened by Washington State; SC = Species of concern, U.S. Fish and Wildlife Service

Alternative A (No Action)

Direct and Indirect Effects: Crupina infests many of the *Pellaea brachyptera* sites in the project area. If crupina infestations are not treated dense crupina stands could prevent the establishment of new *P. brachyptera* plants. Untreated crupina infestations in *Spiranthes porrifolia* sites could lead to a decline in the populations. Crupina infestation may already have contributed to a decline in numbers of *S. porrifolia* at one site in the project area (Arnett and Gamon, 1990). *Githopsis specularioides*, a monitor species, also occurs with crupina. *G. specularioides* is a small annual plant which could easily be out-competed by crupina. If crupina populations are not controlled crupina may eventually spread to *E. gigantea* sites. Under this alternative there would be no risk of accidental damage to TES plants from spray drift, trampling, or heat disks.

Cumulative Effects: Past actions (see Affected Environment for Native Vegetation, page 3-7), decrease the ability of the ecosystem, including TES plants, to withstand invasion of noxious weeds. Foreseeable future actions, which are also ongoing activities, include recreational use of the trail and campsites, trail maintenance, recreational livestock grazing, weed treatment on private land, and fire suppression are not likely to further affect sensitive plants. Recreational livestock grazing occurs around the campsites at Prince Creek and Moore Point. Fire suppression activities increase the likelihood of crupina spread because of the movement of personnel through infested areas, and ground-disturbing actions like fireline construction. This alternative would not contribute to an adverse cumulative effect to TES plants; however, it would not do anything to mitigate the effects of past and future foreseeable actions.

Alternative B (Only Hand-pulling Method Used)

Direct and Indirect Effects: The use of only hand-pulling would avoid the risk of non-target plant injury or death from herbicide drift, however, there would be some trampling and soil disturbance. Trampling could result in death or damage to TES plants. Because *P. brachyptera* is a relatively large perennial plant with deep roots, and because it grows on rock outcrops, it is not likely to be damaged by trampling. However, *S. porrifolia*, which grows in vernally wet seepage areas, would be vulnerable to trampling early in the growing season when crews would be pulling crupina. *E. gigantea* would also be vulnerable to trampling early in the growing season. *G. specularioides*, because it is a small annual plant, would be the most vulnerable to trampling of the four species.

Mitigation measures requiring populations of TES and monitor plants to be marked in advance of weed treatment, requiring crews to wait until TES and monitor species are identifiable before pulling crupina in known sites, and requiring weed pulling crews to be trained to identify sensitive plants would minimize accidental damage from trampling during hand-pulling. With these mitigations, no adverse effects to TES or monitor plants are expected.

Hand-pulling would reduce the density of crupina around sensitive plants, reducing competition for water. However, because hand-pulling dense patches of crupina is both time-consuming and expensive, it is unlikely that all of the crupina could be pulled in any given season. Thus the sites would likely be continuously re-invaded from other sites that were not pulled. TES and monitor plant sites with crupina infestations would need to be hand-pulled every year.

In terms of cultural treatments (seeding) following weed treatment the use of local, native seed would not have an adverse effect on the native vegetation and may prevent the invasion of other weed species. If local seed is not available, the use of native cultivars is not expected to have any adverse effects on native vegetation, because such cultivars are already present in the project area.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct and Indirect Effects: Alternative C would use a mix of hand-pulling, herbicides, and radiant heat disk treatments. As in Alternative B, hand-pulling would reduce the density of crupina around TES and monitor plants, but would pose some risk of death or injury from trampling. Mitigation described in the Alternative B discussion would help prevent adverse effects from trampling.

Herbicide treatment would also help protect TES and monitor plants from crupina competition. However, with herbicide use, there would be a risk of accidental plant injury or death from spray drift. The herbicides picloram and glyphosate would damage or kill any of the four sensitive species known to occur in the project area (*P. brachyptera*, *S. porrifolia*, *E. gigantea*, *G. specularioides*) if accidentally sprayed. Mitigation measures requiring that TES and monitor plants be identified and buffered 25-feet prior to herbicide treatment, and requiring treatments be delayed until TES and monitor species are identifiable would help protect TES and monitor plants from accidental damage from spray drift. The mitigation would be effective in preventing adverse effects to TES and monitor plants.

Radiant heat disks kill weeds by heating plant tissue to the point of cellular break down. Any TES or monitor plant within reach of the 4-inch diameter heat disk would be damaged or killed. Mitigations requiring TES plants to be identified, marked and buffered 25-feet prior to treatment would be effective in minimizing accidental heat damage. The radiant heat disk would only be used when the danger of starting a fire is low, early in the spring when the vegetation is still green and in areas without accumulations of dry or dead plants.

The combination of hand-pulling, herbicides, and radiant heat disk would allow more crupina-infested acres to be treated in any given season. Treatment of more acres would decrease the risk of re-invasion of TES and monitor plant sites, and increase available habitat for TES and monitor species. With

proposed mitigation, this alternative would not adversely affect TES and monitor plant populations.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks

Used—No Motorized Equipment or Mechanical Transport in Wilderness)

Direct and Indirect Effects: Alternative D, like Alternative C, includes hand-pulling, herbicides, and radiant heat disks. Effects to TES and monitor plants are the same as in Alternative C.

Alternative D would treat fewer acres with herbicide than Alternative C. Therefore there is less risk of accidental damage or death of TES and monitor plants from herbicide in Alternative C. However, because the hand-pulling of dense patches of crupina is time-consuming and expensive it is unlikely that all of the crupina could be pulled in any given season. Many areas would continue to be re-infested by patches that were not hand-pulled. With Alternative D there is a decreased risk of herbicide injury but an increased risk of competition from crupina. With mitigation, this alternative would not adversely affect TES and monitor plant populations.

Cumulative Effects for All Action Alternatives (B, C, or D): Past actions, ongoing actions, and future foreseeable actions are the same as in cumulative effects discussion for Alternative A. The action alternatives, with associated mitigation, would not contribute to an adverse cumulative effect to TES plants, and may reduce the impacts of past and foreseeable future actions by removing crupina from TES sites.

3.1.7 Survey and Manage Plants: Affected Environment

The 2001 amendment to the 1994 Northwest Forest Plan organized Survey and Manage into several categories. Categories A and C require pre-disturbance surveys, as well as strategic surveys. Category A requires management of all known sites; however category C only requires management of high-priority sites.

Eleven Survey and Manage vascular plant, bryophyte, lichen, and fungi species could occur on the Wenatchee portion of the Okanogan and Wenatchee National Forests (**Table 3-2**). The Rex Creek fire burned the entire project area, eliminating old-growth conditions required by Survey and Manage species. None of these species have potential habitat in the project area. One vascular plant species, *Botrychium montanum*, was located above Moore Point. The site is over 4,000 feet in elevation and is not potential crupina habitat. Several field surveys for vascular plants have been completed in the project area. Arnett and Alverson surveyed the area in 1984 and 1985 as part of a floristic

reconnaissance of the Lake Chelan–Sawtooth Wilderness Area. Additional surveys have been conducted as part of Forest Service crupina mapping efforts, Washington State Natural Heritage Program monitoring, and Chelan County PUD botanical surveys of the Lake Chelan shoreline. The most recent surveys were in the spring and summer of 2002. Crupina sites were evaluated as potential survey and manage habitat. No survey and manage species were located.

3.1.8 Survey and Manage Plants: Environmental Consequences

Direct, Indirect, and Cumulative Effects: No survey and manage species are known to occur in the project area, therefore no adverse direct, indirect, or cumulative effects are expected. Design features and mitigation measures would help prevent accidental damage to Survey and Manage plants that may have been missed in earlier surveys, similar to that reported in the sensitive plant section.

No adverse effects to the *B. montanum* site are expected because it is outside the area of potential crupina habitat.

Table 3-2. Survey and Manage species that could occur on the Wenatchee portion of the Okanogan and Wenatchee National Forests.

	Category	Habitat	In Crupina project area?
Fungi			
<i>Bridgeoporus nobilissimus</i>	A	1,000-4,000 feet; parasite on <i>Abies</i> sp.; mesic to wet microsites in forests of all seral stages in the range of Pac. silver fir and noble fir; all known sites have Pac. silver fir and noble fir as substrate.	No
Lichens			
<i>Hypogymnia duplicata</i>	A	1,100-5,500 feet; old growth mountain hemlock/Pacific silver fir, mountain hemlock parkland and old growth w. hemlock; epiphyte on boles and branches, mainly mountain hemlock, also on western hemlock, Pacific silver fir, subalpine fir and Douglas-fir	No
<i>Lobaria linata</i>	A	700-1,100 m.; old growth forests in Pac. Silver fir and mt hemlock zones in mesic to moist Alaska huckleberry assoc.; on lower boles of conifers esp. Pac silver fir, also on moss-covered rocks in cool, shaded, humid microsites; found in open subalpine fir forests, on moss in dwarf shrub community and in Douglas-fir/oceanspray/baldhip rose plant association	No
<i>Pseudocyphellaria rainierensis</i>	A	330-4,400 ft; epiphyte on conifers in old growth forests in w. hemlock or lower silver fir zones; reported on Douglas-fir, Pacific silver fir, western hemlock, subalpine fir, Pacific yew, Sitka spruce, western red cedar, bigleaf maple, vine maple, red alder, cascara, chinquapin, and black cottonwood	No
Bryophytes			
<i>Schistostega pennata</i>	A	mineral soil in shaded pockets of overturned roots; often w/ standing water near; moist crevices, caves, and under buildings; requires high humidity and densely shaded microsites	No
<i>Tetraphis geniculata</i>	A	rotten stumps and logs in shaded, humid sites at low to mid elevation; adequate shade	No
<i>Tritomaria exsectiformis</i>	B	rotten logs or peaty soils near low-gradient mountain streams	No
Vascular plants			
<i>Botrychium montanum</i>	A	dark conifer forests near swamps and streams from 3,300 to 9,800 feet; usually with western red cedar	No
<i>Coptis trifolia</i>	A	small wetland areas in western hemlock and Pacific silver fir zones	No
<i>Galium kamschaticum</i>	A	1,500 to 3,500 feet; low angle slopes with saturated soils under dense shrub thickets in old growth canopy gaps; moist, cold conifer forests and mossy places	No
<i>Platanthera orbiculata var. orbiculata</i>	C	mature to old growth stands; mesic sites with shade and deep, moist, undisturbed litter; western hemlock and Pacific silver fir zones	No

3.1.9 Wildlife and Wildlife Habitats: Affected Environment

The following discussion describes general wildlife habitat conditions within the analysis area and how they are affected by the presence of crupina. This section also provides an integrated affected environment description for Threatened and Endangered wildlife species present in the area. These species are interrelated due to dependence, at least seasonally, on shrub-steppe habitats. Other species of concern will be introduced later, preceded by a brief discussion of habitat and presence within the project area.

Wildlife habitat in the project area consists primarily of shrub-steppe, grasslands, scattered ponderosa pine/Douglas-fir stands, rocky cliffy areas, and semi-riparian habitats in intermittent draws. Key wildlife species present include ponderosa pine-dependent species, mountain goats, wintering bald eagles, and mule deer. Most of the area is designated wilderness with small areas of developed recreation, but also supports small areas of functional mule deer winter range, and large areas of mountain goat winter range at the upper limits of the known weed infestation. Habitat, including security/core habitat, is present for gray wolves and grizzly bears, but is affected by some unique factors. Though much of the project area is more than 500-meters from the lake (considered the major access route up-lake – much like a road from a disturbance point of view) and high use Lakeshore, Prince Creek, or Fish Creek trails, the habitat quality is low due to topographic positioning and disturbance from floatplanes (about fifteen trips per week). The slopes along the lake are steep; areas more than 500-meters from the lakeshore are easily visible from the lake and subject to noise from both boats and aircraft, particularly in narrower portions of the lake gorge.

A grizzly bear sighting was reported in the early 1990s in the Hunts Bluff area but follow-up surveys by ground and by air confirmed presence of black bears. No wolf sightings have occurred in the area. Presence of wolves and grizzly bears within the project area is unlikely due to the poor condition of the shrub-steppe and grassland habitats, and the previously described impacts to security/core habitat. Bald eagle sightings are common in the lakeshore area in the winter, but not common in summer.

The Rex Creek wildfire of 2001 substantially affected habitat conditions over the entire project area. The fire generally resulted in a loss of overstory, increase in snag (dead tree) habitat, decrease in old growth/forest habitat, temporary decrease in riparian cover/nesting habitat, and decrease in habitat stability for riparian/aquatic species. The last item is due to the potential for post-fire flooding, particularly in Fish Creek. Loss of the overstory and ground cover greatly increased the potential for crupina infestations to expand.

Suitable habitat for crupina includes south-facing slopes between the lakeshore and 3,000 feet elevation. This is also suitable habitat for wintering mountain goats and/or mule deer. Wintering areas for mule deer are limited but important in the area and are currently in a degraded condition due to past grazing by

horses and sheep, and to the presence of cripina, which displaces native forage species for wildlife. Rockier portions of the infested area at higher elevations are important wintering habitat for mountain goats and cripina has degraded forage opportunities in these areas by displacing preferred native species. Loss of the overstory (trees) has increased the importance of forage quantity and quality on these ranges due to increased energy requirements when thermal cover is not available. The presence of cripina degrades both the quantity and quality of forage, and consequently the productivity of the ungulates dependant upon the range, and prey production for carnivores.

Though domestic grazing no longer occurs in the area except from occasional recreational use, livestock were likely an important vector of cripina spread during the initial infestation. Cripina typically occurs in the areas that were previously heavily grazed. Currently, large ungulates such as mountain goats and mule deer probably continue to spread cripina seed, most likely by attachment to feet or fur. Browsing on cripina has not been observed. Rodents are known to cache seeds as well and probably also contribute to spread. Cripina seed has been determined to be viable after excretion from deer, cows, horses, and upland birds. It is not viable after passing through domestic sheep (Thill et. al., 1986).

Cripina occupies habitat that would otherwise produce important spring foraging resources (such as bulb producing plants) for grizzly bears. The infested and potentially infested suitable habitat for cripina would provide potential spring emergence habitat for grizzly bears. Winter-killed deer are an important spring foraging resource for grizzly bears. Mule deer winter range degraded by cripina also affects potential habitat for grizzly bears. Loss of habitat quality for winter foraging affects carrying capacity, leading to a lower population and fewer winter-killed deer in the long run. Lower ungulate populations of both mule deer and mountain goats also affect population potentials for predators like the gray wolf.

Winter-killed deer are also an important food source for bald eagles. Bald eagles are common in the up-lake areas in the winter, particularly in Prince and Rattlesnake Creeks. There is a potential nesting territory at and around Domke Lake across Lake Chelan from the project area, and an occupied nesting territory along the Stehekin River just up-lake from the project area. Winter-killed mule deer may play an important role in maintaining resident bald eagles in the area, particularly early in the nesting season. The current poor condition of the range supports fewer deer, and consequently produces fewer winter-killed deer, than would be the case if weeds such as cripina did not infest the area.

Changes in the herbaceous component of shrub-steppe habitat (cripina and weeds such as cheatgrass, prickly lettuce, etc.) affect the ability of the site to establish and support bitterbrush and change the foraging and cover opportunities for small mammals and birds (Knick and Rotenberry, 1995). Bitterbrush and native bunchgrass establishment may be reduced or excluded on

such sites (Updike *et. al.*, 1989; Melgoza and Nowak, 1991; and Young *et. al.*, 1987). Changes in small mammal and bird populations in turn affect prey availability for raptors or reptiles that may be present in the area (e.g. peregrine falcons or striped whipsnakes).

Habitat for riparian dependent species such as ruffed grouse and beaver is minimally impacted by crupina infestations (infestations in riparian areas are light), as is habitat for primary cavity excavators (infestations do not affect snags or large trees). Habitat for water birds is not affected due to the lack of crupina in water or lakeshore habitats. Species not present in the project area include Canada lynx, northern spotted owl, Pacific fisher, and marbled murrelet due to a lack of suitable habitat.

3.1.10 Wildlife and Wildlife Habitats: Environmental Consequences

Boundaries: Unless otherwise specified, the geographic boundary for all wildlife effects analyses, including cumulative effects, is the analysis area. This includes areas infested with crupina or with potential to be infested with crupina.

Temporal boundaries are set at the time of the onset of range degradation (*circa* 1910) through the period of known and expected treatment (1989-2014).

Direct and Indirect Effects Common to all Wildlife Species

Radiant Heat Disk: Under Alternatives C and D, the use of the heat disk would be unlikely to cause direct adverse effects or impacts to any wildlife species due to the unlikely presence of animals in the vicinity of the heat disk during use. Fossorial species that may be present underground would be insulated by the soil and would not be affected due to the relatively shallow penetration of radiant heat. Disturbance effects would be the same as described for herbicide treatment crews in the species descriptions to follow (small crews, short-term disturbance, and low potential for animal displacement). The use of the disk and the attendant mitigation measures for disk use would be unlikely to affect native vegetation that provides forage or cover for wildlife due to the poor quality of the habitat in treatment areas (see Native Vegetation, page 3-7). The mechanical heat disk would cause no adverse impacts to any wildlife species.

Cultural Treatments (Seeding): Under Alternatives B, C, and D, seeding of native grasses, either locally collected seed or native cultivars that are already established, would occur where treatments have been conducted in areas with other non-native plants and limited native seed sources. This would provide benefits to all wildlife species by reducing the potential for the other non-native plants to invade sites vacated by crupina, thereby improving native forage and cover.

Cumulative Effects Common to all Wildlife Species

These general effects apply to all species except where different or additional effects are described for individual species.

Alternative A: Several past activities and events affect the current condition of the analysis area including: 1) range use by both sheep and horses that ended in the early 1990s with the suspension of the Round Mountain Allotment (effects persist in terms of continued degraded range condition); 2) the discovery and treatment of crupina by both large and small crews beginning in 1989; and 3) several wildfires (Fish Creek, 1990; Pioneer Creek, 1998; and Rex Creek, 2001). Other than incidental grazing associated with occasional recreational stock use, past stock grazing practices have been major contributors to the poor condition of the range and the expansion of several non-native invasive species including crupina, *Poa bulbosa*, and *Bromus tectorum*. The presence of these invasive species affects the ability of native vegetation such as bitterbrush to recover even where crupina has been successfully reduced (Melgoza et. al., 1990; Melgoza and Nowak 1991; Young et. al., 1987; and Updike et.al.,1989). In the absence of treatments, presence of crupina and these other invasive species would continue to degrade shrub-steppe, grassland, and ponderosa pine habitats, affecting all wildlife species that depend on these habitats for forage, cover, and/or prey production.

Past fires have shown that in absence of treatment, or with minimal treatment and/or inadequate follow-up, weed infestations increase and become so dense that little vegetation is available for wildlife browse or forage. The Rex Creek wildfire added many new acres of concern for possible reduction in shrub-steppe, grassland, and ponderosa pine habitats. Past hand-pulling and spraying efforts on private land have in some cases increased levels of infestation (reducing habitat values) in areas where funds were not available for follow-up treatment. Foreseeable future actions include continued recreational use and trail maintenance including some limited stock use, and periodic fire and subsequent fire suppression activities. Each of these activities has the potential to spread crupina. Adjacent landowners may treat weeds, including herbicides, under any of the alternatives.

With the cessation of hand-pulling activities under the Alternative A, the existing poor range condition from past grazing activities, the lack of follow-up on areas previously hand-pulled, the reduction in native plant cover and expansion of weed populations due to past fires, the continuation of recreation trail and maintenance activities that provide a vector for weed spread, and the potential for future wildfires and fire suppression actions, all would contribute to a situation where crupina continues to expand and presents a greater risk of spread to areas outside the current infestation area (see cumulative effects discussion, Alternative B). Without treatment, crupina would likely spread not only to the suitable habitat in the Rex Creek wildfire area and up-and down-lake along the Lakeshore Trail and boat landings, but also to shrub-steppe, grassland, and

ponderosa pine habitat throughout the Chelan Basin and perhaps the Columbia Basin. This would degrade habitat conditions for all species dependent on these types of habitats. With education, trail maintenance crews would not likely spread crupina. Weed treatments done on private land may slow the rate of crupina spread.

Alternative B: Hand-pulling weed treatments along the trail corridor would counteract the possible spread of crupina along the trail and out of the area, reducing the potential for past and future activities to cause cumulative effects outside the analysis area. However, experience has shown that hand-pulling over the entire infestation area is slow and not completely effective, leading to a low likelihood of reducing the existing effects from past activities over the analysis area during the project lifespan. Hand-pulling treatments would not add to effects (*i.e.* expansion of crupina) that would potentially result from foreseeable future actions related to recreation, trail maintenance, stock grazing, or fire and fire suppression. This alternative would be likely to result in an increase in the infestation in the analysis area due to existing conditions, lack of effective treatment, and potential for future expansions related to fire and recreational activities. Crupina treatments would likely be needed beyond the project lifespan. The area of effect would include shrub-steppe, grassland, and ponderosa pine habitats within the analysis area. The spread upslope would be limited by the elevational limits of crupina, though wildlife or stock may carry seeds up and over the Sawtooth Ridge or into other low elevation areas. If crupina is treated on private land, the rate of spread may slow, but these areas are not high quality wildlife habitat.

Alternative C: Cumulative effects would be similar to Alternative B for all hand-pulling activities. Additional activities involving the use of herbicides and heated disks would tend to improve the effectiveness of the treatments, reducing the overall potential for adverse effects from crupina expansion within the analysis area. This conclusion is based on implementation of treatments as planned including follow-up treatments, seeding, and monitoring. Follow-up seeding would ensure that herbicide treatment would not increase the bare ground available for infestation. Due to low application rates, spot application methods, and the lack of previous herbicide treatment on the National Forest lands, no cumulative herbicide effects on wildlife species or native vegetation that provides wildlife forage is expected. This alternative would likely prevent spread up- and down-lake and into the larger Lake Chelan basin, which would prevent future impacts to native vegetation and maintain wildlife habitat. With crupina populations reduced more so than with Alternatives B and D, the risk of upslope spread upslope would be limited. There would also be less chance of wildlife or stock transporting seeds up and over the Sawtooth Ridge or into other low elevation areas. If crupina is treated on private land, the rate of spread may slow but these areas are not high quality wildlife habitat.

Alternative D: Same as Alternative C except that only half as many acres would receive the potential reduction of adverse effects associated with the effectiveness of treatments with the use of herbicides or heated disks. Lack of effective treatment in a larger portion of the analysis area would be likely to result in expansion of the infestation, but not from the treatment itself. Because crupina populations along the Lakeshore Trail and at campsites and boat landings would be effectively treated, it is unlikely that recreationists, trail maintenance activity, or stock use would spread crupina seed up- or down-lake on clothes, boots, or animals. Because of the lack of treatment in more remote areas, it is likely crupina would spread from these areas and impact native vegetation important to wildlife. Crupina treatments would likely be needed beyond the project timespan. The spread upslope would be limited by the elevational limits of crupina, though wildlife or stock may carry seeds up and over the Sawtooth Ridge or into other low elevation areas. If crupina is treated on private land, the rate of spread may slow, but these areas are not high quality wildlife habitat.

3.1.11 Threatened or Endangered Wildlife Species

See preceding Affected Environment section for a discussion of the habitats, presence, and conditions for all Threatened and Endangered Species

Gray wolf

Alternative A (No Action)

Direct and Indirect Effects: No treatment would occur and crupina would be expected to continue to increase in suitable habitat within the Rex Creek fire area due to the reduction in native plant cover that resulted from the fire. Gray wolf prey species such as mule deer are likely to be affected by a reduction in forage quality and quantity on up to 5,000 acres (a 10-fold increase in the infested area) of shrub steppe / ponderosa pine habitat. A decrease in habitat quality of this magnitude is likely to affect mule deer herd productivity in the area, reducing prey production for wolves. This alternative would have no effect on den or rendezvous sites, as none are known or suspected in this highly viewable area. Potential disturbance to wolves or prey from treatment activities would not occur. Soil disturbance from hand-pulling and foot traffic would not occur, reducing these potential impacts to native vegetation and mule deer forage. Effects to native vegetation from crupina expansion (long-term effect to vegetation if treatment does not occur) are likely to be far greater than the effects of reduced soil disturbance resulting from cessation of hand-pulling activities. The potential soil disturbance due to foot traffic would be short-term.

Cumulative Effects: Geographic boundaries include the infestation area as well as mule deer summer ranges along the Sawtooth Ridge and winter ranges down-lake. If hand-pulling activities stopped, the existing poor range condition from past grazing activities, the lack of follow-up treatment on areas that had been previously pulled, the reduction in native plant cover due to past fires, continued

recreation activities that provide a vector for weed spread, and the potential for future fires would all contribute to a situation where crupina continues to expand and presents an elevated risk of spread to areas outside the current infestation area (See also cumulative effects discussion, Alternative B). This could potentially degrade mule deer/wolf habitat throughout the analysis area and the Chelan and Columbia Basins.

Alternative B (Only Hand-pulling Used)

Direct and Indirect Effects: Possible displacement of wolves due to disturbance from work crews with 36-42 people present in one location. Hand crews work within several feet of each other. The maximum size of any work group in a single location is typically 36-42 people and half that size in wilderness. This would affect about $\frac{1}{2}$ acre of non-wilderness at any one time (36-people working in a line, plus 6-people scouting and doing quality control). The displacement distance from the work group(s) would be larger if buffered by $\frac{1}{3}$ mile on all sides. The buffered displacement area would be about 255-acres. In wilderness, the workers would be split into smaller groups in several locations, decreasing each area potentially affected to about 251-acres including the buffer. For several groups, the overall potential displacement would be about 500-acres. This potential disturbance would occur from about mid-March through mid-June for a maximum of 48-worker days. Much of the area potentially disturbed is located more than $\frac{1}{3}$ mile from the lakeshore, or the Lakeshore, Fish Creek, and Prince Creek trails and could provide security habitat. However, due to the shape of the lake gorge (a narrow, confined valley through the crupina-infested areas), and the visibility of these steep south-facing slopes from both lake and the air, this potential security habitat is already diminished by sounds from lake and air traffic. Though located more than $\frac{1}{3}$ mile from the lake, or major trails, all treatment areas are within sight and sound of human activity. Work parties would therefore represent little actual change in habitat conditions other than a temporary loss of access to areas with low value due to current weed conditions.

Possible disturbance/displacement of mule deer (wolf prey) during the spring green-up period which could result in energy costs to mule deer at a critical time and reduced access to forage. This effect would potentially occur at a time when mule deer energy reserves are low and demands are high (pre-fawning), but the likelihood of deer presence is reduced by the poor condition of the range. Reduction of crupina would improve habitat quality (see following paragraph).

Possible improvement in browse/foraging conditions for prey species in areas that are successfully treated (about 100-acres every 3 to 5 years). Hand-pulling has proven to be labor intensive which affects the number of acres that can be treated. Hand-pulling also has no effect on the existing seed bank, a fact that reduces treatment effectiveness. Except where crupina is scattered and/or terrain is rough, hand-pulling results in fewer acres treated (improved) per unit effort (acres treated per day per person), as compared to herbicide use, and

requires annual treatment for at least 3-years since seed viability is 2-3 years. Additionally, hand-pullers treat only seedlings present and accessible on the day of treatment, missing delayed germinants and plants in hazardous locations (cliff areas and rocky and shrubby areas where rattlesnakes are likely). Reduced crupina populations would improve wildlife foraging conditions more than Alternative A but likely less than Alternative C, and similar to Alternative D.

Possible reduction in browse/forage production due to soil impacts related to foot traffic. Minor soil disturbance due to foot traffic does occur during hand-pulling treatments, especially as crews work in close proximity, leaving relatively little of the areas undisturbed. This effect is greatest on steep slopes where some soil displacement occurs. Foot traffic usually occurs only once each year for a minimum of 3 years on any one piece of ground. Impacts from foot traffic would not kill native vegetation unless substantial soil displacement occurs (rare due to overriding safety concerns). This is more likely to occur with annual grass and forb species than plants with deeper roots. The most likely effect on mule deer browse/forage would be on annual species that either contribute little to mule deer forage (e.g. native annuals) or are ephemeral non-natives (cheatgrass) that displace more important native plants (bitterbrush). Foot traffic on flatter ground may result in minor soil compaction and trampling of native vegetation but is unlikely to have long-term effects due to the relatively low weight of hand-pullers and single impact per year. Follow-up seeding with native grasses would mitigate some of the impact to soils, but would have relatively little impact on browse conditions in areas where cheatgrass is heavily intermingled with crupina. Seeding of native grasses would decrease the chances of crupina or other non-native species filling the space that was occupied by the pulled crupina. Soil impacts would likely be more than Alternative A, and the same for hand-pulling treatments under Alternatives B, C, and D since the same areas would be hand-pulled in all action alternatives. Hand-spraying activities in Alternatives C and D would add a small amount of additional foot traffic. However, over time, foot traffic impacts under Alternative B would continue, whereas improved treatment effectiveness and control with the use of herbicides under Alternative C (and to a lesser extent Alternative D) would allow foot traffic to diminish for all treatment activities over time, reducing potential impacts to vegetation and maintaining or improving browse/forage production.

There would be no effect on den or rendezvous sites, as none are known in the infested area, and the likelihood of presence is low. Though unsurveyed, the weed infested areas are highly visible from the lake and the airway, have been visited by survey crews multiple times during spring, summer, and fall over the past 14-years. Likelihood of undetected presence during the spring period is low.

Cumulative Effects: As described in the general cumulative effects section, hand-pulling treatments alone are unlikely to effectively reduce the existing extent of the infestation that has resulted from past fires and range activities. The result would be continued degradation of mule deer foraging habitat, and

potential reduction of wolf prey availability. This result is not, however, a result of the treatment itself, and is therefore not a cumulative effect. Without effective crupina treatment, seed is more likely to spread by recreationists, stock, and future fires and fire suppression actions. This would continue to adversely affect mule deer habitat.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct and Indirect Effects: Possible displacement of wolves due to disturbance from large hand crews. Under this alternative hand-pulling would continue but would be supplemented with the use of herbicides. The amount of disturbance under this alternative would be similar to Alternative B as there would still be large work parties “sweeping” previously treated areas and moving into new areas. Additionally small herbicide crews would be working throughout the infested area. These crews would rarely be larger than 2-3 people and would not impact security habitat. Due to the residual activity of the herbicide that would treat seeds with delayed germination, fewer treatments (two rather than a minimum of three) would be needed, and over time, fewer people in smaller groups would be needed to accomplish treatment. Possible disturbance would be more than Alternative A and, over time, less than Alternatives B and D.

Possible displacement of wolves or prey due to disturbance from mechanized transport (helicopters) used to stage water or other equipment. Under this alternative, helicopters would be needed to stage water for backpack sprayers, and may be used to stage other equipment. Helicopters would be used no more than one day per week from about mid-March through mid-June, a maximum of about eight days per year. No new helispots would be constructed and water/equipment would be staged by long-line in areas where helispots are not present. Landings would occur only in a few areas due to the rugged terrain (limited natural/pre-existing helispots) and restrictions on helispot construction. Disturbance from helicopter use would likely cause the immediate area to be vacated by wildlife (predator and/or prey) during the period when the helicopter is less than 500-feet above the ground. This would occur for no more than 30-minutes in any one location, and would not likely occur in more than 10-locations in any day. All helicopter related disturbance would occur in the area already affected by noise from floatplane and boat traffic. Disturbance would be temporary and localized in areas with existing disturbance. Security habitat values would return to current levels on non-helicopter days and from mid-June through mid-March each year. Other than disturbance previously described for hand-pulling crews, disturbance to wolf security habitat from helicopter activity would only occur under Alternative C. Displacement would slightly reduce the amount of foraging habitat available for predator and prey short-term, though the quality of this habitat is low due to the current level of weed infestation. Overall, the likelihood of displacement is low due to low probability of wolf presence and the limited duration and incidence of disturbance.

Possible displacement of wolves or prey due to disturbance from motorized equipment (pumps) near streams. Pumps would be used to fill upslope water containers for mixing herbicides. Duration of use in any one location would likely be less than 1 week per year, and the operation of the pumps would likely occur for only an hour or two per day. Motorized equipment is already in use on the lake, in the air, and on private land within the crupina infestation area. Pump use is not likely to increase noise or disturbance levels above ambient levels except in the immediate vicinity of the pump. Some wildlife avoidance/displacement is possible in these areas. This effect would only occur under Alternative C on National Forest System land, though it could also occur on private lands under Alternative D. Overall, likelihood of displacement is low due to low probability of wolf presence and the limited duration and incidence of disturbance.

Possible disturbance/displacement of mule deer (wolf prey) if present in the area during the spring green-up period, which could result in energetic costs to mule deer in the critical pre-fawning period, and displacement of both mule deer and gray wolves if present. In addition to the disturbance previously described under Alternative B, mule deer could also be disturbed by additional spraying activities and motorized use under this alternative. Few deer currently use the area due to its present degraded condition and those deer present would be likely to move only short distances due to the relatively non-threatening nature of the hand-pulling activities. This conclusion is based on actual observed mule deer behavior during hand-pulling activities. Due to the addition of small hand-spraying crews (several groups of 2-3 people each); more area per year would be likely to be subjected to disturbance under Alternative C than Alternatives B or D. However, the increased effectiveness of the treatment is likely to reduce the overall number of needed treatments, decreasing the number of years that treatment is needed compared to Alternatives B or D.

Possible improvement in browse/foraging conditions for prey species in areas that are successfully treated. Use of herbicides would increase the number of acres that can be treated. It would also have a residual effect on the seed bank, increasing the effectiveness of treatment, and reducing the need for repeated treatments (2 rather than 3 visits, monitoring and follow-up spot treatments would be similar). Follow-up seeding of native grasses would decrease the chances of crupina or other non-native species invading the treated areas. Forage conditions are likely to improve more quickly and occur over more acres under this alternative than Alternatives B or D. Some non-target native vegetation would be impacted by spraying activities – measures to use hand application methods (backpack sprayer), to spray only where native vegetation is already compromised, and to seed sprayed areas would mitigate this effect and maintain or improve foraging conditions. In areas 10-50 feet from water where native vegetation is already compromised by crupina/cheatgrass infestations, use of glyphosate would reduce both invasive species and improve the potential establishment of important browse such as balsamroot and bitterbrush, improving foraging conditions for mule deer (Updike *et. al.*, 1989).

Possible reduction in browse/forage production due to soil impacts related to foot traffic. As described under Alternative B, some soil disturbance would result from foot traffic. Under Alternative C, additional foot traffic would occur during backpack spraying activities; however, sprayers disturb less soil per area treated. Spray wands enable a longer reach and fewer treatments would be needed over time, resulting in less overall soil disturbance and impact to mule deer foraging conditions than under alternatives where herbicides are not used. Additionally, most important mule deer winter range browse species are deep-rooted and not likely to be affected by foot traffic. Competitive seeding of native grasses would mitigate some soil disturbance over the long run, reducing soil related effects on forage production.

Possible reduction in forage/browse due to application of herbicide to non-target native vegetation. The use of spot application methods with backpack sprayers would limit effects on non-target species to those plants within a very short distance of the target plants and the rooting zone. Picloram may injure some perennial native plants including bitterbrush, but recovery within a year or two is likely (Miller, 1982). Some native annuals may be affected, but due to the spot spraying method, others would remain in the vicinity to provide seed. Glyphosate would only be used on crupina plants in the vicinity of water, high water table areas with sandy soils, or where the native plant community is already severely reduced. In the latter case, non-target vegetation would consist largely of cheatgrass, *Poa bulbosa*, and other non-native species. Few, if any, native species would be affected, and the use of glyphosate would not affect native seed due to the lack of residual activity of this herbicide. Reduction in crupina and particularly, cheatgrass, would improve reproduction of bitterbrush important to wintering deer.

No effect on den or rendezvous sites. Same as Alternative B.

Possible toxic effects to wolves or mule deer from use of herbicides. Herbicide effects would not occur either through direct application or ingestion of treated vegetation since wolves are carnivores. Any effect would be secondary through consumption of prey (e.g. mule deer, small mammals) that eats treated vegetation. This effect is unlikely due to the limited presence of wolves in the area (previously discussed lack of truly remote habitat) and the time-span between a mule deer eating vegetation on the spring range and a wolf consuming the deer at least a month later on the summer range where wolf presence is more possible. Picloram is considered relatively non-toxic to terrestrial animals (SERA, 1999; USDA, 2000; USDA, 2002). Picloram does not bio-accumulate, is excreted in urine of animals that graze upon treated vegetation (Dow Elcano, 1994), and is little threat to secondary consumers. Most herbicide treatments would not occur in fawning habitat and most would be completed in advance of the May-June fawning season. Use of glyphosate is also expected to result in levels of exposure below those of concern at

anticipated application rates (see Risk Assessment, section 4.4.1, SERA, 1996; and Tu *et. al.*, 2001).

Cumulative Effects: Effects are as described in the general cumulative effects section. No additional effects are expected for wolves or prey.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Use of Motorized Equipment or Mechanical Transport in Wilderness)

Direct and Indirect Effects: Effects are as described for Alternative B except that there would be about 50-acres per year of herbicide treatment. On wilderness land there would be no motorized equipment or mechanized transport. On other National Forest System land and on private land, logistical support from motorized equipment or mechanized transport would be permitted. None of the potential treatment areas meet requirements for security habitat. Herbicide spraying effects would be similar to Alternative C except that half as many acres would be treated. All of these areas are located in the vicinity of the lakeshore and/or Lakeshore Trail where security habitat does not currently exist. Due to the proximity of these areas to the lakeshore, trail, as well as roads on private land, little helicopter support would be needed, and if needed, would occur only over non-security habitat.

Cumulative Effects: Effects are as described in the general cumulative effects section. No additional effects are expected for wolves or their prey.

Grizzly Bear For all alternatives, effects on grizzly bears are the same as those described for wolves/mule deer with the following exceptions:

Alternative A (No Action)

Direct and Indirect Effects: Grizzlies utilize mule deer winter-kill more than actively preying on mule deer. The no action alternative would result in additional degradation of the winter range due to increase cripina infestation. The already low mule deer population is likely to further decrease, reducing the amount of winter-kill available in the long run.

Potential increases in cripina would further decrease the productivity of spring bulbs and forbs in the area, reducing the quality of the spring foraging habitat for grizzly bears (currently 500-acres, but up to about 5,000-acres of potential infestation). Spring emergence habitat is a limiting factor in the North Cascades Grizzly Bear Ecosystem. Much of the area infested with cripina could potentially offer spring emergence habitat. The area is relatively small but, if un-infested, would be of high quality due to proximity to remote habitat and connectivity to other seasonally important habitats (berry fields, sub-alpine meadows, talus

fields, potential denning habitat). With no action, this potentially important habitat would continue to degrade.

Core habitat for grizzly bears is described in the same manner as security habitat for gray wolves (1/3-mile from roads or high use trails). The quality of this habitat is also influenced by boat and air traffic as described for wolves. As with gray wolves, the No Action Alternative would have no effect on the security value of grizzly bear core habitat. The current infestation would continue to affect 111-acres of core habitat, and potentially as much as an additional 1,972-acres of core habitat as the untreated areas of suitable habitat become infested.

Cumulative Effects: Geographic boundaries would extend to the crest of the Sawtooth Ridge, and include seasonal habitats at higher elevations where effectiveness of the habitat is limited by the condition of the most proximate spring emergence habitat (e.g. the crupina infested areas). Effects would be similar to those described for gray wolves. Additionally, no action, combined with on-going effects of past actions, and the potential for future fires, would result in expansion of crupina in spring foraging habitats, consequent reduction of spring forage for grizzly bears, and a reduction in habitat effectiveness (see Alternative C cumulative effects discussion for grizzlies) in this portion of the Upper Chelan Bear Management Unit (BMU).

Alternative B (Only Hand-pulling Used)

Direct and Indirect Effects: Possible displacement of grizzlies due to disturbance from large hand crews. The potential effect would be as described for wolves except that any grizzlies present in the area would likely be foraging for spring bulbs and plants rather than preying on mule deer. Most winter-kill would be gone prior to project initiation. Treatment areas are of poor quality as foraging habitat due to current weed infestation levels. Based on the lack of bear sightings in this remote but visible area, and to the poor quality of the habitat, it is unlikely that bears would be displaced from the treatment area, though some areas in the vicinity (maximum extent of which is as described for wolves) may be avoided. This would be a temporary effect, occurring only on treatment days. Core habitats disturbed would be restored on completion of treatment activities. Hand-pulling treatment of the 111-acres of known infestation in core habitat would reduce the rate of spread into the additional 1,972-acres of potentially suitable crupina habitat in grizzly core areas, but (based on past experience) would be unlikely to completely prevent spread.

Possible displacement of mule deer during spring green-up period. Disturbance and displacement during this period may have energetic costs to pregnant does during the month prior to fawning, potentially affecting herd size and ability of grizzlies to forage on winter-kill or to opportunistically prey on fawns. Extensive disturbance during this critical time could potentially reduce fawn production and winter-kill availability; however, experience over the last 14-years has shown that

deer are rarely disturbed by hand crews and seldom move far. It is unlikely that there would be an effect on grizzlies.

Possible improvement in spring foraging conditions in areas that are successfully treated. Hand-pulling would have a minimal impact on native plant species that would provide grizzly forage. Removal of crupina would increase growing space for native forage species, unless other non-native species (e.g. cheatgrass, *Poa bulbosa*) fill the space, which is likely without the combination of herbicide use and competitive seeding. Because of these factors, this alternative is less likely to improve foraging conditions than Alternative C and about the same as Alternative D because the additional habitat treated under Alternative D is located close to human developments, and is of lesser quality. This alternative is more likely to improve foraging conditions than Alternative A because crupina spread would eventually be slowed or stopped through continued hand-pulling.

Possible reduction in forage production for grizzlies due to soil impacts related to foot traffic. Same as Alternative B for wolves/mule deer.

There would be no effect on potential grizzly denning habitat since denning does not usually occur at the low elevation, south aspect areas infested with crupina.

Cumulative Effects: Same as Alternative B for Wolves, except that geographic boundaries are limited to the area between the infestation and the Sawtooth Crest (full seasonal range of habitats are present) and would not likely include down-lake winter ranges. Quality of the spring emergence habitat in the infested area limits the effectiveness of seasonal habitats at higher elevations and Alternative B results in less effective treatment than Alternatives C or D, and therefore lower quality spring emergence habitat and less effective habitat overall.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and R radiant Heat Disks)

Direct and Indirect Effects: Possible displacement of grizzlies due to disturbance from hand crews. Same as Alternative B – addition of small 2-3 person hand crews would not affect core habitat as these parties are small and visits would not occur in any one area more than once per season.

Possible displacement of mule deer during spring green-up period. Same as Alternative B – addition of small 2-3 person hand crews would be unlikely to cause sufficient disturbance to affect herd productivity.

Possible improvement in spring foraging conditions in areas that are successfully treated. Same as Alternative B except that adding use of herbicides (with mitigation measures) would increase the effectiveness of treatments through residual herbicide activity, extended reach, and faster treatment. The chances of

other non-native species invading the site would be lower on sites treated with glyphosate and the chances of late crupina germinants re-infesting the site would be lower on sites treated with picloram because residual herbicide would kill plants for about 18 months. In either case, more weeds would be treated than under Alternatives A, B, or D, and the likelihood of re-infestation is lower than with hand-pulling alone due to the combined effects of reseeding and residual activity. Reduced weed infestations would increase habitat availability for re-establishment of native species, and would increase spring forage availability for grizzlies.

Possible reduction in grizzly forage production due to soil impacts related to foot traffic. Effects are as described for wolves under Alternative C except that mule deer browse species are less important to grizzlies. Effects to bulb producing species would, however, be similar as these species tend to root below the zone of potential soil disturbance. Some spring forbs may be affected by foot traffic, but this effect is unlikely to occur in areas that might attract grizzly bears due to the existing degraded conditions in these areas.

There would be no effect on potential grizzly denning habitat as this activity does not usually occur at the project area elevations or on south aspects.

Possible displacement of grizzlies due to disturbance from helicopters. Same as Alternative C for Wolves.

Possible displacement of grizzlies due to disturbance from motorized pump use. Same as alternative C for Wolves.

Possible reduction in forage for grizzlies due to application of herbicide to non-target native vegetation. Targeted species include only non-native vegetation. Picloram may affect native species within about a foot or less of the target plant rooting zones. This includes bulb-producing plants that provide grizzly forage. Perennials also can be impacted by picloram but are rarely killed at proper application rates (Dow Elcano, 1994). These plants are likely to recover from unintentional spraying (Miller, 1982), and would benefit in the long run from the removal of competition from crupina. Glyphosate would only be used in limited areas near water, areas with a high water table and sandy soil, and where native vegetation is already compromised and does not currently offer foraging opportunities, consequently, glyphosate use is not likely to impact grizzly forage.

Possible toxic effects on grizzlies from the use of herbicides. Grizzlies are unlikely to be in the area when spray is being applied due to the existing poor quality of forage and lack of remote character in the habitat. Neither direct application nor contact through spray drift is likely to occur.

Potential toxic effects on grizzlies from use of herbicides on potential forage. Grizzlies may ingest treated vegetation. The likelihood of this occurring is low

due to the existing low quality of the vegetation in the areas to be treated, the proximity of many of the treatment areas to human use zones, and the lack of known grizzly presence in the area. Picloram is considered relatively non-toxic to terrestrial animals (USDA, 2002; SERA, 1999), and is excreted in animals that feed on treated vegetation (does not bioaccumulate). Effects on large bodied animals are minimal. Use of glyphosate is also expected to result in levels of exposure below those of concern at anticipated application rates (USDA, 1997 and 2002; SERA, 1999), especially considering the immediacy of effects to vegetation and consequent loss of palatability, lack of residual herbicide activity, and current poor condition of the range.

Cumulative Effects: Effects are the same as Alternative C for wolves, except that the geographic boundaries would extend to the crest of the Sawtooth Range, and include seasonal habitats at higher elevations where effectiveness of the habitat is limited by the condition of the most proximate spring emergence habitat (e.g. the crupina infested areas). Improving the foraging conditions on the spring emergence habitat would reduce current adverse effects and improve the effectiveness of grizzly bear habitat on the north shore portion of the Upper Chelan BMU.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used,--
No Use of Motorized Equipment or Mechanical Transport in
Wilderness)

Direct and Indirect Effects: The effects of hand-pulling treatments would be as described for grizzly bears in Alternative B. None of the potential treatment areas meet requirements for security habitat. Possible toxic effects on grizzlies from the use of herbicides. Grizzlies are unlikely to be in the area when spray is being applied due to the existing poor quality of forage and lack of remote character in the habitat. Neither direct application nor contact through spray drift is likely to occur.

Cumulative Effects: The effects would be the same as those described under Alternative C for Grizzly bears except that half as many acres would be treated with herbicides, leading to less effective treatment of those infested acres with the highest quality of remote habitat, reducing potential habitat effectiveness as compared to Alternative C (but more than Alternatives A or B).

Northern Bald Eagle

Alternative A (No Action)

Direct and Indirect Effects: Bald eagles use the project area primarily in the winter. Scattered sightings occur all along the north shore of Lake Chelan. Within the project area, they are seen most often in the Rattlesnake and Prince Creek areas. This alternative contains no activities that would affect bald eagles or eagle habitat. The effects of crupina spread are described in the Gray Wolf section above. Expansion from the edges of existing crupina populations by wind, rodents, or other vector would cause continued degradation of mule deer winter range that would further reduce carrying capacity. This would potentially result in small, short-term increases in winter-kill with a longer term reduction in population and winter-kill.

Cumulative Effects: Geographic boundaries for cumulative effects analysis for all alternatives include the upper north shore of Lake Chelan where eagles winter, as well as the Stehekin River Bald Eagle Recovery Territory and the Domke Lake potential recovery territory, both located in or near the project area. Due to past treatments that would not receive necessary follow-up treatment, past range activities, and past and future fires, the crupina infestation would expand under this alternative. Potential crupina spread from recreational activities, trail maintenance, campsites and boat landings, and fire and attendant fire suppression activity would cause continued degradation of mule deer winter range, further reducing carrying capacity and potentially resulting in small short-term increases in winter-kill and long-term reduction of population size that would ultimately lead to a reduction in winter-kill over the long run. This reduction could affect the ability of eagles to winter in the area, but would not necessarily affect the ability of eagles to nest in either of the adjacent territories. Nesting activity is more dependent on the associated fisheries rather than the availability of winter-kill, though some reduction in winter-kill availability that supports early season nesting activities could occur.

Alternative B (Only Hand-pulling Used)

Direct and Indirect Effects: Under this alternative, hand-pulling activities would occur during the spring when bald eagle presence is rare. The Domke Lake recovery territory overlaps the lower end of the crupina infestation from just up-lake of Rattlesnake Creek to the vicinity of Meadow Creek. The Stehekin River Recovery Territory is up-lake of the project area but eagles may forage over the project area. Presence of large crews may disrupt feeding on any winter-kill in the area; however, the disruption would occur only for a few hours in any one area in any one year. Morning and evening feeding would still be possible on treatment days and the effect would be small. It is possible that this effect could occur during the early part of the nesting period. Hand-pulling activities would not affect nest or perch trees. The only potential nesting stands within the

crupina area were located on either side of Rex Creek and were burned in the 2001 wildfire. No nest activity occurred in either stand before or after the fire.

Cumulative Effects: As the crupina infestation is gradually controlled, winter range conditions would improve in treated areas, potentially supporting a larger mule deer population and more available winter-kill in the long run. Hand-pulling, while able to contain the infestation thus far, has been shown to be inefficient for long-term control of crupina. This alternative is likely to result in less improvement in the winter range (less reduction of the existing cumulative effects) than Alternatives C or D, though it is likely to prevent the infestation from escaping the currently infested area. Any new infestations that occur in wilderness from the Rex Creek fire or other fire suppression activity, or spread from recreational use, trail maintenance, campsites, and boat landings, would not be treated with herbicides and not likely to be controlled by hand-pulling alone (based on 14-years of experience).

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct and Indirect Effects: Effects of treatment would be similar to Alternative B for hand-pulling treatments. In addition, herbicides would improve the effectiveness of treatments, allowing more area to be treated, and allowing fewer treatments on many sites. In the long run, this would result in a reduction in the potential disturbance of bald eagles feeding on winter-kill, as compared to hand-pulling alone. Herbicide use would not affect nest trees, roost trees, or potential nesting or roosting habitat. Herbicides would not be present in winter-killed animals as application would occur in spring. Use of glyphosate for aquatic applications or hand-pulling near streams would eliminate the potential for contaminating the fishery or bald eagles potentially feeding on the fish (SERA, 1996 and 1999, USDA, 1997 and 2002). Major fish-bearing streams include Fish and Prince Creeks, which have little or no crupina in adjacent areas. Streams with the highest adjacent weed infestation levels (Rex, Pioneer, and Rattlesnake Creeks) have no fish, and do not provide a foraging source for bald eagles. Using conservative assumptions for spray drift, modeling has shown that any herbicide that reaches streams or Lake Chelan would be below any threshold of concern (see water section below).

Cumulative Effects: Use of herbicides would improve the effectiveness of the overall treatments, reducing the effects of past incomplete treatments, past range activities and past/future fires. This would tend to improve the quality of the winter range, potentially allowing the range to support a larger mule deer population that would provide more winter-kill over the long run. This winter-kill may contribute food sources to support early season nesting for bald eagles on the Stehekin River and potential establishment of occupancy in the Domke Lake territory. No adverse cumulative effects from the use of herbicides are

anticipated due to the types of herbicides used, the spot application methods, and follow-up seeding and monitoring.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Motorized Equipment or Mechanical Transport in Wilderness)

Direct and Indirect Effects: Effects under this alternative are similar to Alternative C except that the increased effectiveness of treatments that include herbicide use would only occur on half as many acres, most of which offer slightly lower quality habitat due to the proximity to human developments. Using conservative assumptions for spray drift, modeling has shown that any herbicide that reaches streams or Lake Chelan would be below any threshold of concern (see water section below).

Cumulative Effects: Effects are similar to Alternative C except that reduction in cumulative effects that result from the improved effectiveness of treatments that include herbicide use would only occur on half as many acres. Any new infestations that occur in wilderness from the Rex Creek Fire, or spread by recreational use, trail maintenance, campsites, and boat landings would not be treated with herbicides and are unlikely to be controlled by hand-pulling alone (based on 14 years of hand-pulling).

Northern Spotted Owl – Crupina does not occur in spotted owl habitat and the project would have no effect on spotted owls.

Canada Lynx – Crupina does not occur in lynx habitat and the project would have no effect on lynx.

Pacific Fishers strongly prefer areas with overhead tree cover and are not likely to be present in the treatment areas. The U.S. Fish and Wildlife Service is initiating a 12-month status review of this species.

Marbled Murrelet – There is no habitat present in the project area for Marbled Murrelets and the project would have no effect on this species.

Designated Critical Habitat for Marbled Murrelet and Northern Spotted Owls: None in project area.

3.1.12 Summary Effect Determinations for Gray Wolf, Grizzly Bear, and Bald Eagle

Table 3-3. Summary Effect Determinations for Gray Wolf, Grizzly Bear, and Bald Eagle

	Alternative A (1)	Alternative B (2)	Alternative C (3)	Alternative D (4)
Gray Wolf	Adverse effect	Not Likely to Adversely Affect	Not Likely to Adversely Affect	Not Likely to Adversely Affect
Grizzly Bear	Adverse effect	Not Likely to Adversely Affect	Not Likely to Adversely Affect	Not Likely to Adversely Affect
Bald Eagle	Adverse effect	Not Likely to Adversely Affect	Not Likely to Adversely Affect	Not Likely to Adversely Affect

(1) Adverse effects are on wildlife habitat, no direct adverse effects on species
 (2) This alternative would limit cripina spread outside analysis area, slightly reducing detrimental effects. The treatment would cause a temporary disturbance.

(3) This alternative would limit cripina spread within and outside the analysis area, greatly reducing detrimental effects. The treatments would cause a temporary disturbance.

(4) This alternative would limit cripina spread outside the analysis area and in the more developed portions of the analysis area. The detrimental effects of cripina would be reduced more than Alternative B and less than Alternative C.

3.1.13 Sensitive Wildlife Species

Townsend's Big-eared Bats are not known to inhabit the project area but presence is possible. There are no known hibernacula or maternity roosts in the project area. Caves and adits known within the project area show no evidence of bat presence or activity. Important habitat features such as large snags would not be impacted by either the cripina infestation or any of the proposed treatment methods. Work parties are relatively small and noise associated with treatments under any of the action alternatives would not occur at a level that would disturb bats potentially roosting in the few large snags present near infested areas. The project would not impact big-eared bats, and no cumulative effects are expected.

California Wolverine presence within the infestation area is unlikely due to the lack of remote habitat and current poor condition of the winter range that might otherwise provide winter-kill food sources. Effective treatments of cripina on the winter range are likely to increase the carrying capacity of the habitat, leading to a potential increase in episodic production of winter-kill foraging sources for wolverines. Due to the increased treatment acreage, reduced number of treatments on each acre, and treatment of seed bank through residual activity of herbicide, Alternative C is likely to be the most effective treatment and increase the carrying capacity of the winter range. Alternative D would also improve the carrying capacity, but to a lesser degree than Alternative C and in less important habitat (near human developments). Alternative B would show some improvement. Under Alternative A, winter range carrying capacity would continue to decrease in both mule deer winter ranges and mountain goat winter

ranges. Herbicide and disturbance effects of action alternatives would be as previously described for wolves and grizzly bears. Cumulative effects would be as described earlier.

Ferruginous Hawk – Although some incidental foraging may occur over the shrub-steppe habitats within the infestation area, this area is outside the predicted range and recovery zone as described by the Washington Department of Wildlife (WDFW, 1996). Additionally, hawks often eviscerate prey, reducing the risk of ingesting herbicide that may have been present on vegetation consumed by prey species (WDFW, 1996). All action alternatives are likely to improve habitat conditions for small mammals by restoring native vegetation and foraging conditions, potentially benefiting any hawks foraging over the area. The no action alternative would allow the native vegetation to continue to degrade, reducing forage availability and habitat quality. Cumulative effects would be as described under the general section.

American Peregrine Falcons likely forage over riparian areas within the infestation area. Observations have been confirmed in the Lone Fir drainage, just down-lake of the infestation, and across the lake on Lightning Ridge and Graham Harbor Creek. Due the productive nature of riparian areas, and the competitive advantage that native species have in these favorable conditions, crupina infestation levels are generally low. The No-Action alternative would not be likely to result in additional degradation of riparian habitats, though adjacent upland habitat would likely become less diverse both in structure and in species, potentially leading to a decrease in bird productivity (Knick and Rotenberry, 1995). All action alternatives are likely to improve upland habitat conditions with the greatest improvements potentially occurring under Alternative C where herbicide use and competitive seeding would likely show the greatest improvement in structure and diversity of the vegetation. This could potentially improve bird production and foraging habitat for peregrines. Cumulative effects would be as described under the general section. Herbicides proposed for use do not bioaccumulate and would not contribute to existing DDT/DDE effects on peregrine falcons within the Chelan Basin.

Gray Flycatchers may be present in ponderosa pine/bitterbrush stands but are more typical in sagebrush/pinon pine areas. Unconfirmed sightings have been reported in the Union Valley area, about 28-miles southeast of the down-lake edge of the project area, in an area that supports both sagebrush and bitterbrush. Expansion of both crupina and cheatgrass would be likely under the No Action alternative, potentially reducing the regeneration of the bitterbrush component in these shrub steppe areas (Updike *et. al.*, 1989). No action would likely cause a reduction in potential habitat for Gray flycatchers. The action alternatives, especially Alternative C that includes the use of picloram and glyphosate, are likely to reduce crupina/cheatgrass (though reduction would be minimal under Alternative B), improve bitterbrush, and hence shrub-steppe

regeneration, which would improve potential habitat for gray flycatchers. Cumulative effects would be as described under the general section.

Sharptail Snakes live in damp conditions and feed almost exclusively on slugs. They are often found at forest edges and near open water (Storm and Leonard, 1995). Crupina habitat is damp only during snowmelt and offers no suitable habitat for sharptail snakes. Scattered crupina plants do occur in some riparian areas that provide potential sharptail habitat. Crupina does not currently threaten these habitats nor is it likely to under the No-Action Alternative. Hand-pulling scattered plants under Alternative B is also not likely to threaten potential habitat due to minimal soil disturbance with this method. Use of herbicides in Alternatives C and D would be limited within potential sharptail habitat and spot spraying crupina would have little effect on non-target vegetation. Effects would be limited to existing vegetation since glyphosate has no residual effect (SERA, 1996 and 1999; USDA, 1997 and 2002). None of the action alternatives are likely to have an adverse impact on sharptail habitat due to the limited distribution of crupina in these habitats, low intensity of treatments, and low likelihood of sharptail presence due to the lack of slug prey. Cumulative effects would be as described under the general section.

Striped Whipsnakes may be present within the crupina infestation area, though no sightings have been reported. The project area is outside the projected core or peripheral zones determined under the Washington Gap Analysis project (Dvornich, 1997). Potential habitat includes arid areas with scattered vegetation and open rocky areas below 2,000 feet elevation (Storm and Leonard, 1995). This snake is more typically associated with sagebrush steppe habitats rather than bitterbrush steppe typical of the project area. If present, action alternatives are likely to improve shrub-steppe habitat conditions, particularly under Alternative C where treatments would likely be more effective due to increased acreage, fewer treatments, and residual herbicide effects on crupina seed bank. Herbicide use is unlikely to affect this species due to unlikely presence at times and places of application, and low toxicity of the chemical, especially via skin contact with treated vegetation (no ingestion). Cumulative effects would be as described under the general section.

California Mountain Kingsnakes are rare in the Pacific Northwest. Knowledge of kingsnake biology is limited, though the species favors moist habitats in oak and pine forests and in chaparral. Typically the snakes are found beneath or within rotting logs, substrate that is not common in the project area. If present, the most likely location would be riparian areas where project activities are limited. Alternative A would have little effect on these habitats. The action alternatives would slightly improve habitat conditions, though the effect is not likely to be measurable. Adverse impacts from herbicides or foot traffic from hand-pulling are not expected due to the low intensity and lack of residual activity of the herbicide. Cumulative effects would be as described under the general section.

Sensitive Species not analyzed include those clearly associated with bodies of water or wetlands, neither of which occur in infested areas (e.g. common loon, eared grebe, sandhill crane, northwest pond turtle), or the project area is outside the range of the species (larch mountain salamander), or habitat is lacking (upland sandpiper).

3.1.14 Wildlife Management Indicator Species (MIS)

Management Indicator Species potentially present in the project area are those associated with dry forest openings and low-density areas, and several unique habitats including hardwoods, riparian/wetland areas, talus/scree, cliffs/caves, meadows and shrub areas, and edges. These habitats and species are shown in **Table 3-4 (see Appendix H)**, and described below. The cripina areas, and therefore treatments, usually occur in non-forested areas. Occasional presence in forested areas occurs where canopy cover is low. Successionally-advanced dry forest areas with high canopy closure and/or multiple canopy layers do not occur in the infestation area due to the Rex Creek fire. **Table 3-4** also displays broad scale habitat trends by rating relative habitat availability and identifying species with declines in habitat capability (as assessed for the Interior Columbia Basin – Lehmkuhl *et al.*, 1997; Lehmkuhl *et al.*, 2001; and Wisdom *et. al.*, 2000). Management Indicator Species with broad scale declines in habitat trends or capability include some primary cavity excavators and mule deer.

Mountain goats are commonly seen throughout the project area, though most sightings are at the upper elevation limit of the infestation in rocky and steep areas, and then only during the winter. Although it is likely that cripina presence displaces preferred native browse species for mountain goats, it is not known whether mountain goats browse on cripina. Most use of the infestation area would occur during the winter when cripina plants are barely visible as 2-leaf seedlings that may or may not be browsed upon. Over the past 14-years, hand-pullers have not observed cripina plants browsed by any wildlife though rodent caches have been observed (Machus, Ranne, personal communication). Surveyors able to access the most likely goat habitat in steep and difficult conditions have also not observed browsing on cripina plants (Machus, personal communication). Later in the season when plants bolt and potentially provide more substantial browse, most goats have moved to higher elevations. By the time the goats return in late fall, cripina plants have withered and died. Cripina therefore offers little potential as a forage species for mountain goats.

Cripina infestations in the rocky habitat preferred by goats tend to be at a low density (less degraded range conditions due to reduced access to sheep and horses in the past). The ecological threat is not so much directly to these rocky habitats but as a continuing seed source to infest or re-infest more suitable habitat at lower elevations. Mountain goat habitat would be at some risk of continued degradation from the infestation under the No-Action alternative, but

more importantly, harbors plants that are difficult to treat under any alternative, and would provide a continuous supply of crupina seed if left untreated. Under all alternatives, much of the habitat in this area is too steep to safely spray due to the added weight and balance concerns associated with use of backpack equipment on steep ground, but some of the habitat could be treated with herbicides where water, equipment, and crews are staged by helicopter (Alternative C). Hand-pulling is usually the preferred option under all action alternatives and where infestations are of low density hand-pulling would reduce seed production and re-infestation of adjacent areas below. Denser areas below these steep slopes could be sprayed, but spraying would occur during a time when mountain goats are not likely to be present. Sprayed vegetation would therefore be unlikely to be browsed upon and goats would not likely be disturbed. Alternative C offers the most improvement in habitat conditions for mountain goats due to the added ability to treat denser patches of vegetation more effectively. Alternatives B and D would be the same in mountain goat habitat, and would potentially reduce less of the crupina infestation than Alternative C. Under Alternative A, the infestation would be likely to increase, potentially resulting in further degradation of mountain goat forage. Most of the additional potentially suitable crupina habitat that was opened up by the Rex Creek fire is in mountain goat habitat. Cumulative effects would be as described under the general section.

Ruffed grouse and beaver are both management indicator species for riparian habitat. Crupina density in riparian habitat is generally low due to the more productive nature of these types of habitat and better competitive abilities of native species under these conditions. The Rex Creek fire did reduce canopy closure in many riparian areas, making the sites more suitable to crupina infestation but little increase appears to be occurring at this time. Under the No Action Alternative, some increase may be expected over time as infestations increase in adjacent areas. As the riparian overstory recovers, crupina would lose its competitive edge but is likely to persist, reducing forage and cover for ruffed grouse, though the reduction is likely to be small. Increased crupina density is not likely to have a great impact on beaver since the preferred shrub and tree forage crown sprouts after fire and would regenerate without competition from crupina. Under Alternative B, minor soil disturbance would occur from foot traffic and hand-pulling but would be of low frequency (once per year), and minimal impact (one person making a single pass in any one place). Grouse browse is not likely to be affected and may be slightly improved by reduced competition from crupina. Beaver browse would remain unaffected as it consists of deep-rooted perennial shrubs and trees that can compete with crupina and withstand hand-pulling treatments. Under Alternative C, glyphosate may be used in combination with hand-pulling in riparian areas. Spot spraying would reduce impacts to non-target vegetation. Glyphosate has no residual activity and would not affect native species that may sprout after spraying and sprayed vegetation would die and disappear rapidly, providing little opportunity (and little enticement) for browsing. Ruffed grouse are not likely to be affected by

the use of herbicides, or by reduced forage. Beaver prefer species that are easily avoided by spot sprayers, so there would be no impact. Neither species is likely to be affected since no herbicides would be used within 10 feet of water. Any potential drift of glyphosate over water would not likely affect beaver because glyphosate breaks down rapidly and is specifically recommended for aquatic applications (SERA, 1996 and 1999; USDA, 1997 and 2002). Under Alternative D, fewer riparian areas would be available for spraying slightly reducing the opportunity to reduce the cripina infestation and improve conditions for native browse species. Cumulative effects would be as described under the general section.

Pileated woodpeckers forage largely on insects that inhabit standing and down woody material, most often in old growth habitats or habitats capable of producing larger snags and debris. The species is unlikely to be affected by any of the alternatives as cripina rarely occurs in forested environments, and has little ecological impact when it does due to the inhospitable nature of these sites for cripina. Pileated woodpeckers may, however, forage in low-density ponderosa pine stands that may have cripina infestations in and around them. Hand-pulling and spraying activities may temporarily disrupt potential foraging habitat, but likely for only a few hours per year in any one location. High-density cripina infestations may impede conifer seedling establishment. The likelihood that this would occur is low due to the fact that cripina seedlings are most likely to establish in previously forested areas where loss of the overstory canopy creates vulnerable habitats. The infestations would invade from adjacent areas and would likely move slower than winged conifer seeds. Cripina seed is heavy and rarely travels more than 3-feet from the parent without assistance from water or wildlife. Re-establishment of pines that would develop into suitable foraging habitat for pileated woodpeckers is likely to occur in spite of cripina infestation (see also discussion under Primary Cavity Excavators). Spraying activities are unlikely to affect conifer regeneration as tree seedlings are easily identified as non-target vegetation and can be avoided, and are likely to withstand some amount of spray drift due to their perennial deep-rooted nature (Dow Elcano, 1994). Though some root uptake and damage may occur, it would not be extensive enough to affect regeneration of low-density stands typical of these habitats. Cumulative effects would be as described under the general section.

Mule deer (see also the gray wolf, grizzly bear, and bald eagle) -- The broad scale decline in habitat capability for mule deer is a concern under the Alternative A, as predicted increases in cripina infestation would cause further decline in habitat capability on the upper north shore of Lake Chelan. All action alternatives would reduce the rate and extent of the decline with the greatest improvements occurring under Alternative C, followed by Alternatives D and B, though the effect under Alternative B would likely be limited to reduction of spread rather than actual reduction in the infestation. Cumulative effects would be as described under the general section, as well as the grizzly bear and wolf sections.

Primary Cavity Excavators (PCEs) (Williamson's sapsucker, Lewis' woodpecker, red-breasted sapsucker, hairy woodpecker, downy woodpecker, white-headed woodpecker, and northern flicker) – Most of these species feed on insects on snags or on seeds and insects produced by mature trees. Important habitat features, such as snags, would not be affected by crupina infestations or by treatment activities (see above discussion for pileated woodpeckers). There is a slight possibility that regenerating trees (ponderosa pine and hardwoods such as aspen and big leaf maple) could be affected either by increasing crupina density (Alternative A), or by herbicide use (Alternatives C or D), or by soil disturbance associated with hand-pulling/foot traffic (Alternatives B, C, or D). Due to the crown-sprouting ability of hardwoods, increasing crupina density is not likely to reduce hardwood regeneration. It is also not likely to reduce conifer regeneration due to existing seed sources for conifers, winged nature of the conifer seeds, and the gap between initial establishment of conifer seedlings (first year after fire) and initial establishment of dense crupina (years 2 through 5 after the fire). Due to these factors, conifers are likely to establish before crupina infestations become so dense that they exclude other species from the site, particularly in previously forested areas where crupina seed sources are low. Conifer seedlings inadvertently sprayed with picloram are likely to recover (Dow Elcano, 1994; see also pileated woodpecker discussion). Soil disturbance may occur but is likely to be small in magnitude (one person, once per year in any location) and both deep-rooted and crown-sprouting species would be resistant to complete displacement.

Though most PCEs depend on snags, mature trees, and/or riparian areas, some use alternate foraging strategies. Both the northern flicker and the Williamson's sapsucker occasionally feed on the ground. These species may forage in crupina infested areas, and may contact herbicide treated vegetation or ingest insects that have been exposed to herbicides. Although this may occur, it is likely to occur only on small, scattered portions of the landscape that offer little potential foraging habitat due to the crupina infestation. Sprayed areas are not likely to attract foraging woodpeckers and those that inadvertently ingest vegetation or insects exposed to herbicides would also be foraging in adjacent untreated areas that are more extensive and are more attractive for foraging. If treated vegetation or insects were ingested, herbicide would be excreted with little harm to the bird (SERA, 1996 and 1999; USDA, 1997, 2000; and 2002; and Dow Elcano, 1994). Lewis' woodpeckers are attracted to burned areas and are likely to inhabit the project area within the decade. They hawk for insects and are attracted to brushy areas that produce abundant insect prey. These conditions do not currently occur in the treatment areas and are unlikely to occur in areas that are or become infested with crupina. Due to these conditions it is unlikely that the use of herbicides under Alternative C or D would impact PCEs, or that any of the alternatives would have a measurable impact on these species. The project would not contribute to further declines in broad scale species viability trends. Cumulative effects would be as described under the general section.

Elk are rarely, if ever present in the project area and would not be affected by activities.

3.1.15 Northwest Forest Plan Wildlife Species

Wildlife species include the white-headed woodpecker, black-backed woodpecker, pygmy nuthatch, and flammulated owl, Canada lynx, bats (e.g. fringed myotis, silver-haired bat, long-eared myotis, long-legged myotis, pallid bat, Townsend's big-eared bats), and great gray owl. With the possible exception of the great gray owl, none of these species are likely to inhabit the project area and/or be affected by project activities due to the lack of suitable habitat and previously described effects considered (see PCE, Townsend's big-eared bat, and ruffed grouse/beaver sections). Both great gray owls and Canada lynx favor habitats at higher elevations and are not likely to be present in the project area. None of these species would be adversely impacted by any of the proposed alternatives, though continued increases in the level of crupina infestation under the No-Action Alternative are likely to have a cumulative "ripple" effect through the ecosystem, eventually having an effect on all species.

Survey and Manage Mollusks – The project area is outside the range of the Chelan Mountain snail. The blue-gray tail dropper is found in moist conifer and mixed conifer hardwood forests usually located in sites with relatively higher shade and moisture levels than general forest habitats. It is usually associated with partially decayed logs, leaf and needle litter (especially hardwood leaf litter), mosses, and moist plant communities such as big leaf maple and sword fern associations (Duncan *et. al.*, 2003). The majority of the infestation area consists of non-forested low elevation, dry south aspects that do not provide suitable slug habitat. However, prior to the Rex Creek fire, there was a limited amount of moist big leaf maple/mixed conifer habitat present in the project area.

Monadenia spp. was often found in these areas and many burned shells were discovered after the fire. Most of this type of habitat did not support crupina, but the weed was found at the edge of at least one such area in the Meadow Creek/Round Mountain vicinity. This area burned intensely, eliminating most of the habitat features important to tail droppers. Limited riparian/hardwood habitat remains in some draws but crupina is not known to infest these areas. Mitigation to restrict the use of herbicides where big leaf maple litter is present would prevent impacts to any recovering populations in these areas if crupina infestations move in to these areas in the future. Hand-pulling and foot traffic would not impact blue-gray tail droppers due to the current lack of suitable habitat. Expansion of the crupina infestation is also unlikely to impact tail droppers due to the current lack of habitat. None of the alternatives would impact Survey and Manage mollusks. With no effects to these species from activities, no cumulative effects are expected.

3.1.16 Landbirds

The effect of the project on landbirds has been evaluated to fulfill our responsibilities for landbird conservation under the USDA, Forest Service Landbird Strategic Plan and the Presidential Executive Order for the Conservation of Migratory Birds related to the Migratory Bird Treaty Act. Effects are assessed by identifying which priority habitats listed in the East Slope Cascades Mountains Bird Conservation Plan are present in the project area and then identifying focal species of concern. Prior to the Rex Creek fire, priority habitats present in the project area included ponderosa pine forest and aspen areas. Focal landbird species include: white-headed woodpecker, pygmy nuthatch, chipping sparrow, Lewis' woodpecker, and red-naped sapsucker. Effects on all but the chipping sparrow and red-naped sapsucker have been previously described.

Chipping Sparrows are indicative of ponderosa pine regeneration habitats, though this species is often found in human-impacted environments. This habitat was virtually eliminated by the Rex Creek fire, but the fire also initiated a regeneration cycle. Within a decade young ponderosa pine stands would develop and provide potential habitat for chipping sparrows. As described for various species including the PCEs, increased crupina infestations associated with the No-Action alternative are not likely to decrease the potential for ponderosa pine stands to establish. Hand-pulling and foot traffic associated with Alternatives B, C, or D may impact regenerating pines but are not likely to kill them due to the low impact of the effect and deep-rooted nature of these trees. Herbicide use under Alternatives C and D could set seedlings back but is unlikely to cause permanent damage at the prescribed low application rates (Dow Elcano, 1994). Additionally, the spot spraying method would focus on target vegetation with minimal effects to non-target species. When ponderosa pines regenerate, habitat conditions would not be favorable to establishment or persistence of crupina. If crupina is present, low intensity spot spraying and/or hand-pulling would not substantially affect the insect prey base that chipping sparrows use during the breeding/treatment period. None of the alternatives are likely to have an adverse impact on chipping sparrows, and thus, no cumulative effects are expected.

Red-naped Sapsuckers depend on aspen and willow habitats. These habitats are present in limited portions of the project area, generally where crupina populations are low due to excessive overstory cover and productive conditions where other species are more competitive. Crupina would not affect aspen and willow as these are crown-sprouting species that quickly re-establish. Hand-pulling and foot traffic would also not affect establishment of these deep-rooted species. Aspen and willow would also be little affected by the minor soil disturbance associated with weed treatment activities. Herbicide use in aspen/willow habitats is unlikely to affect these deep-rooted woody perennials. Insects that red-naped sapsuckers prey on would potentially be exposed to herbicides in the understory but the risk is low due to low application rate, spot

spraying techniques, and low density of crupina in aspen/willow habitat. The red-naped sapsucker is unlikely to be impacted by any of the proposed alternatives and thus no cumulative effects are expected.

3.1.17 Interior Columbia Basin Ecosystem Management Plan (ICBEMP) Wildlife Species

The only species determined to have low viability ratings during the ICBEMP planning process that may be present in the project area is the rubber boa. This species, if present, would be associated with riparian areas. Rubber boas feed on small mammals but also eat salamanders, lizards, snakes, and birds, all secondary recipients of any herbicides applied in these habitats. Due to the type of herbicide used (glyphosate – no residual activity, no bioaccumulation), minimal density of crupina in these habitats, low application rates, and spot spraying technique, rubber boas are unlikely to be impacted. It follows that no cumulative effects are expected.

Other ICBEMP species of interest may have been present prior to the wildfire but presence is now unlikely due to the loss of dense forest and old growth. Lewis' woodpeckers (also included in the PCE group previously discussed) are likely to be present within the decade as brush recovers and snags soften and fall. Long-eared owls, yellow-breasted chats, and Wilson's warblers may re-establish as riparian areas recover. Potential effects to riparian areas and associated species have been previously described for various species (western gray squirrels, survey and manage mollusks, beaver/ruffed grouse, PCEs, sensitive snake species, etc.). These effects may also apply to rubber boas and re-establishing species as previously described, but no adverse impacts are expected.

3.1.18 Other Wildlife Species of Concern with Special Status

The Columbia spotted frog, east slope Washington Cascades candidate is *Rana luteiventris*, Great Basin Distinct Population Segment (DPS), south of Snake River (USDI, Fish and Wildlife Service, 2002). The Columbia spotted frog was formerly included in *Rana pretiosa*. The two species were separated in 1997 (Green et al., 1997). Of the four sub-populations of *R. luteiventris*, only the Great Basin DPS is considered a candidate at this time (USDI, Fish and Wildlife Service, 2002). Pre-1997 sightings of *Rana pretiosa* near the project area likely include *Rana luteiventris* individuals, and are reported here as potential inhabitants and indicators of potential effects to amphibians.

Spotted frogs are highly aquatic and live in or near permanent bodies of water, including streams and marshes. Sightings have been recorded at Blackpine Lake, about 13-miles NE of the project area (McAllister and Leonard, 1993). Sightings have not been recorded in the infestation area but suitable habitat does

exist along streams. Crupina is rarely present near these types of habitat as it gains competitive advantage on dry, rocky exposed sites and does not compete as well in wet areas. Crupina does not threaten most streamside habitats and where it occasionally occurs near streams, control actions would be taken to prevent seeds from carrying to more suitable habitats, rather than to prevent infestation within streamside habitats. Alternative A would have no effect on Columbia spotted frog habitat. Alternative B would have very little effect on spotted frogs since few plants occur in frog habitat and hand-pulling and associated foot traffic would disturb little soil, and produce little sediment in the stream (see soils section). Use of glyphosate under Alternatives C and D would occur only in limited areas with spot applications affecting few plants and no treatment would occur within 10 feet of streams. Any glyphosate that drifts over surface water would diminish rapidly due to microbial degradation, binding to suspended particles, or dispersion (SERA, 1996 section 4.2.3, Tu *et al.*, 2001). The Round-up® formulation of glyphosate would not be used due to the potential toxic effects of the surfactant (POEA). For most aquatic species, glyphosate levels of 1mg/L are not likely to cause adverse effects. The amount of glyphosate with potential to drift over water in the treatment area is likely to be far less, with no anticipated effect to adults, tadpoles, or eggs. Some sensitive species of algae could be affected (algae is an important food source for spotted frogs); however the effects are likely to be transient given the rapid dispersion and removal of glyphosate from ambient water (executive summary, SERA, 1996; Tu *et al.*, 2001). Herbicide use under Alternatives C and D are not likely to cause toxic effects to spotted frogs either from ingestion of contaminated algae or from absorption through the water. Herbicide use would slightly reduce the effects of soil disturbance associated with hand-pulling and foot traffic that would occur under Alternative B or in areas outside herbicide treatment zones in Alternative D. No cumulative effects are anticipated due to the minimal amount of herbicide that is anticipated to reach aquatic habitats (see hydrology section) and lack of existing effects in these areas.

Western Gray Squirrels are occasionally observed in the project area, primarily in areas with large overstory ponderosa pine or big leaf maple. Currently, the gray squirrel is listed as a Washington State, threatened species. Gray squirrels feed primarily on mast and mushrooms and do not generally forage in the habitats that crupina invades. On the north shore, preferred habitats include areas with big leaf maple and large, old ponderosa pine. Existing large trees are unlikely to be affected either by the use of herbicides or by soil disturbance associated with hand-pulling and foot traffic. Tree seedlings established since the Rex Creek fire would be vulnerable, but are easily recognized as non-target vegetation and would not be sprayed. No spraying would occur where big leaf maple leaf litter may be supporting truffles or other fungi that provide a food source for gray squirrels. None of the alternatives are likely to impact this species, and thus no cumulative effects are expected.

California Bighorn Sheep are not currently present in the project area. The nearest population is located 8 miles southeast of the down-lake portion of the project area. None of the alternatives would directly affect bighorn sheep. Grassland habitats in the area are limited and currently in a degraded condition due to crupina presence and past grazing impact. Treatments that restore grassland habitats (e.g. Alternative C, and to a lesser extent, Alternatives D and B) would likely improve habitat conditions for bighorn sheep should the population expand to this area. Cumulative effects to potential habitat would be as described under the general section.

Golden Eagles commonly hunt over the shrub steppe and grassland habitats on the north shore of Lake Chelan. Nests are not known within the project area. Disturbance during treatment activities may cause eagles to forage elsewhere for a short time (hours). All treatments that reduce crupina infestations (Alternatives C and D, and to a lesser extent Alternative B) would improve habitat for small mammals and birds that depend on native vegetation for forage, and would thus provide some benefit to golden eagles. Herbicides would be used only in habitats with poor foraging opportunities and would therefore offer little risk to small mammal and bird populations. Minimal exposure would occur, and proposed herbicides are not likely to biaccumulate in larger predatory species (Ecological Risk Assessments, USDA, Forest Service, 2002; Dow Elcano, 1994). No cumulative effects are expected.

Northern Goshawk nesting is not likely within the project area due to the current lack of dense forest. Foraging is possible but unlikely due to the extensive effects of the Rex Creek fire and lack of proximate potential nesting habitat. No direct, indirect, or cumulative effects are expected to goshawks.

3.1.19 Aquatic/Fishery Resources: Affected Environment

The following analysis and discussion is a summary of the Fisheries Biological Assessment (see analysis file) conducted by the aquatic/fishery specialist. The project area contains a total of about 155-miles of streams ranging from Class I fish-bearing streams (Prince and Fish Creeks), Class III perennial streams without fish (Canoe, Rex, Pioneer, and Hunts Creeks), and Class IV intermittent unnamed tributaries and springs.

Current known fish distribution in project area streams includes native cutthroat trout, introduced rainbow trout, and introduced kokanee (land-locked sockeye salmon). The Wenatchee Forest Plan designated native cutthroat trout as a Management Indicator Species. Rainbow trout and kokanee have been stocked in Lake Chelan and some of its tributaries since 1917. Many streams in the project area have natural barriers (waterfalls) that prevent lake resident fish (adfluvial type) from entering (see **Table 3-5**). None of the streams in the project area support anadromous fishes due to exclusion by natural barriers in the Chelan River (Chelan Public Utility District, 2000a). Introduced rainbow trout and kokanee have no special status (sensitive, management indicator, proposed, listed, or otherwise).

Table 3-5. Project Area Stream Attributes.

Stream Name	Adfluvial Length	Fish Species Present
Canoe Creek	~50 ft.	None
Prince Creek	1,584 ft.	cutthroat, rainbow, kokanee
Rattlesnake Creek	unknown	unknown
Rex Creek	0	None
Pioneer Creek	0	None
Cascade Creek	450 ft.	cutthroat, rainbow
Meadow Creek	unknown	unknown
Fish Creek	1,312 ft.	cutthroat, rainbow, kokanee
Hunts Creek	0	None

Background: **Table 3-6** (page 3-56) is a checklist that documents the environmental baseline (current condition) of the project area. The Aquatic/Fishery analysis was conducted according to the matrix, checklist, and dichotomous key format of the USDI, Fish and Wildlife Service (USDI, 1998) titled *A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale*. This format was utilized because it parallels the amended Forest Plan Standards and Guidelines for aquatic/riparian areas; utilizes the same habitat indicators for which data have been collected, and the matrix reflects the information needed to implement the Aquatic Conservation Strategy (ACS) and to evaluate effects relative to the ACS objectives.

Riparian Reserves are a key element of the ACS that was designed to restore and maintain the health of watersheds and aquatic ecosystems on public land. The Northwest Forest Plan (NFP) designated the Lake Chelan sub-basin as a Non-key Watershed with Roadless Areas. Chelan Ranger District Line Officers have chosen to adopt the more stringent standards and guidelines for Tier 1 Key Watersheds. The NFP contains standards and guidelines for riparian reserves that prohibit or regulate activities that retard or prevent attainment of the ACS objectives. For example, the General Riparian Area Management Standard and Guideline RA-3: "Herbicides, insecticides, and other toxicants, and other chemicals shall be applied only in a manner that avoids impacts that retard or prevent attainment of ACS objectives".

Riparian reserve boundary width and corresponding classifications include:

Fish-bearing streams - the area on each side of the stream equal to the height of two site-potential trees, or 300-feet slope distance, whichever is greater, corresponds to Class I and II waters;

Permanently flowing non-fish-bearing streams - the area on each side of the stream equal to the height of one site-potential tree, or 150-feet slope distance, whichever is greater, corresponds to Class III waters;

Lakes and natural ponds - the body of water and the area to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300-feet slope distance, whichever is greater, corresponds to Class I waters;

Constructed ponds and reservoirs and wetlands greater than one acre - the area from the edge of the wetland or the maximum pool elevation to a distance equal to the height of one site-potential tree, or 150-feet slope distance, whichever is greater, corresponds to Class III waters;

Seasonally flowing or intermittent streams - the area on each side of the stream to a distance equal to the height of one site-potential tree or 100-feet slope distance, whichever is greater, corresponds to Class IV waters (intermittent streams are defined as any non-permanent flowing drainage features having a definable channel and evidence of annual scour or deposition);

Wetlands less than one acre and unstable and potentially unstable areas - the extent of unstable and potentially unstable areas, and wetlands less than one acre to the outer edges of riparian vegetation, corresponds to Class IV waters.

Current Condition of Habitat (Environmental Baseline): The current condition of project area streams is based on stream surveys of Prince Creek (WNF, 1992), Fish Creek (WNF, 1998), Lake Chelan Fishery Investigations (Brown, 1984),

Lake Chelan Fishery Investigations (CPUD, 2000b), and post-fire burned area surveys in 2001. Extensive burning of riparian habitat during the Rex Creek fire resulted in changed habitat conditions in Prince and Fish Creeks.

Water Quality: Lake Chelan and its tributaries are subject to State Lake Class and Class AA (Extraordinary) water quality standards as determined by Washington State Department of Ecology (DOE) using parameters defined by the Clean Water Act (CWA) 303(d) regulations. In the project area, there are no CWA 303(d) listed water bodies; although the lower lake is listed for several pesticides (see water section).

Water Temperature: Limited data from the project area showed Prince and Fish Creeks meet water temperature standards except for brief excursions (one to several days) beyond criteria during the hottest days of the summer, a naturally occurring condition. Short-term (1 to 5 years) increases in water temperature are expected in burned area streams as a natural result of the Rex Creek fire.

Sediment: The Middle Chelan Watershed Analysis (1999) concluded that fine sediment in project area streams was variable and linked to the intensity and extent of the most recent disturbance (wildfire predominantly). Short-term (1 to 5 years) increases in fine sediment are expected in burned area streams as a natural result of the Rex Creek fire (Swanson, 1991).

Physical Barriers: The geology of the north shore has created falls and chutes in all the streams in the project area. Besides the natural barriers that limit the adfluvial length of the streams, during low streamflow various segments of most streams can present natural upstream fish passage barriers. Native cutthroat trout evolved under this situation and are capable of establishing populations and moving through stream reaches when flows allow.

Substrate Embeddedness: This is a function of fine sediment input and the ability of the stream to transport it. Project area streams have high gradients and large channel bed elements (cobbles, boulders) consequently embeddedness seldom develops above 30%. Short-term (1 to 5 years) substrate embeddedness may increase as a natural result of the Rex Creek fire (Helvey, 1973).

Large Woody Debris (LWD): The Middle Chelan Watershed Analysis (1999) concluded that LWD in project area streams was variable (average: 138 pieces per mile, range: 15 to 342 pieces per mile) and linked to the intensity and extent of recent wildfires, the dominant recruitment mechanism. Short-term (5 to 30 years) increases in LWD are expected in project area streams, especially in Fish Creek, as a natural result of the Rex Creek fire (Swanson, 1991).

Pool Frequency: The Middle Chelan Watershed Analysis (1999) showed that pool frequency (range: 1.8 to 8.9 bankfull channel widths per pool) in Prince and Fish Creeks was functioning appropriately at the geomorphic potential of those

streams and concluded that rock, rather than LWD, is the primary pool-forming element in project area streams.

Pool Quality: Pools in Prince and Fish Creeks are high quality with maximum depths averaging 5.5 feet (range: 3.6 feet to 10.5 feet); mean depths averaging 3.0 feet (range: 2.1 to 3.8); mean residual pool depths averaging 2.0 feet (range: 1.6 to 2.4); and mean pool area averaging 370 square feet (range: 184 to 622).

Off-Channel Habitat: Side channel formation is atypical in Rosgen A-type and B-type streams due to channel confinement by steep valley walls and steep channel gradient. This indicator is not applicable to the project area.

Refugia: Streams in the project area are isolated from re-colonizing populations by natural barriers. Streams that do not host fish populations are important refugia for other aquatic biota that may be preyed upon by fishes. This is especially true of amphibians (Leonard et al. 1993). The project area has not been intensively surveyed for amphibians. The following incidental observations have been documented: Western toad (*Bufo boreas*) and Pacific chorus frog (*Pseudacris regilla*) in Fish Creek (WNF, 1998 and CPUD, 2000c); and tailed frog (*Ascaphus truei*) in Fish Creek (WNF, 1998).

Width/Depth Ratio: Measured bankfull width/depth ratios for Prince and Fish Creeks were mostly <12 which is properly functioning for Rosgen A-type channels. Some segments exhibit bankfull width depth ratios >12 which is properly functioning for those segments (Rosgen B-type channels).

Streambank Condition: Actively eroding streambank has been measured only in Fish Creek in 1998 when bank erosion averaged 2% of all reaches except for 20% eroding bank on the alluvial fan where Fish Creek emerges from a confined valley. This is caused by natural lateral channel migration on the relatively flat alluvial fan. Short-term (5 to 10 years) increases in accelerated bank erosion are expected in project area streams as a natural result of the Rex Creek fire (Swanson, 1991).

Floodplain Connectivity: Floodplain connectivity is completely intact in the project area.

Change in Peak/Base Flows: The Middle Chelan Watershed Analysis (1999) and the hydrology section of this document provide a good discussion of the hydrology of the project area. Peak flows are produced by rain-on-snow events (most common), rapid snowmelt, convective storms, and long-duration advective storms. Short-term (up to 10 years) increases in base flows are expected in the project area (especially in Prince and Fish Creeks) from vegetation loss from the 2001 fire (Robinson and Minshall, 1993).

Drainage Network: In the project area, the drainage network has been moderately increased by the residual effects of livestock trails/grazing (grazing terminated in 1991). The effects of historic sheep grazing are gradually diminishing.

Road Density and Location: The project area is mostly in an unroaded wilderness. Road density is essentially zero except for a few short roads that connect docks and homes on private lands near the lakeshore.

Disturbance History: The Middle Chelan Watershed Analysis (1999) describes this indicator. In summary, the condition of the project area is properly functioning except for a 100-year history of fire exclusion that contributed to the extent and intensity of the Rex Creek fire.

Riparian Reserves: Riparian reserves of the project area are functioning appropriately overall. There has been a slight loss of function (shade, LWD recruitment, bank stability, fine sediment buffering) on stream segments through private land near Lake Chelan. The percent similarity of riparian vegetation to the potential natural community/composition is estimated to be in the 50-80 percent range after the 2001 fire.

Disturbance Regime: The dominant disturbance process in the project area is wildfire. By USDI (1998) diagnostic standards, the project area is functioning at risk – flows are variable and unpredictable, debris torrents are likely, and a high probability of catastrophic fire existed prior to 2001.

The environmental baseline displayed in the following table shows that riparian and aquatic conditions within the project area are mostly "Functioning Adequately".

Table 3-6: Checklist for documenting environmental baseline for Aquatic/Riparian conditions in the Project Area.

Indicators	Functioning Adequately	Functioning At Risk	Functioning At Unacceptable Risk
WATER QUALITY			
Temperature	X		
Sediment	X		
Contaminants & Nutrients	X		
HABITAT ACCESS			
Physical barriers	X		
HABITAT ELEMENTS			
Substrate Embeddedness	X		
Large Woody Debris	X		
Indicators	Functioning Adequately	Functioning At Risk	Functioning At Unacceptable Risk

HABITAT ELEMENTS (continued)			
Pool Frequency	X		
Pool Quality	X		
Off-Channel Habitat	NA	NA	NA
Refugia	X		
CHANNEL CONDITION & DYNAMICS			
Width/Depth Ratio	X		
Streambank Condition	X		
Floodplain Connectivity	X		
FLOW/HYDROLOGY			
Change in Peak/Base Flows	X		
Drainage Network	X		
WATERSHED CONDITIONS			
Road Density & Location	X		
Disturbance History	X		
Riparian Reserves	X		
Disturbance Regime		X	

3.1.20 Aquatic/Fishery Resources: Environmental Consequences

Alternative A (No Action)

Direct and Indirect Effects: There would be no risk of herbicides getting into project area waters; therefore no risk to aquatic species. New ground disturbance associated with the proposed actions would not occur. Natural fire-recovery processes would continue. The expected effects of natural riparian recovery would be variable, dictated mainly by climate conditions over the next 50-years. It is conceivable that the unchecked spread of crupina could detrimentally alter upslope terrestrial processes (nutrient transport and cycling, erosion/sedimentation, water infiltration, storage and routing) that would in-turn degrade riparian and aquatic habitat.

Alternative B (Hand-pulling Only)

Direct and Indirect Effects: There would be no risk of herbicides getting into project area waters; therefore no risk to aquatic species. Potential impacts of increased stream sedimentation to aquatic species from weed control methods involving soil disturbance would occur. Work crews would cause minor site disturbance from foot traffic and the hand pulling operation. Negligible

accelerated erosion would occur and where the hand-pulled areas are adjacent to streams, additional sedimentation in the stream could occur. Grass seeding in areas adjacent to (upslope of) riparian areas would minimize the potential for erosion, and would reduce the potential for sediment to enter active stream channels.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct and Indirect Effects: Two herbicides, glyphosate and picloram, are proposed for use. The following information is taken from the Herbicide Information Profiles (USDA, 1997 and 2000) unless otherwise cited.

Glyphosate is highly soluble in water, remains relatively unchanged after application, and is strongly adsorbed by soil. The potential for leaching is low because the strong adsorption does not allow the chemical to be easily released back into water moving through soil. The half-life for glyphosate in water is 35 to 63 days, while in soils the half-life ranges from 18-months to 4-years depending on soil texture and organic matter content. Tests in British Columbia following glyphosate application using spray and no-spray streamside zones showed, with a no-spray zone, low concentrations were sometimes found in water and sediment after the first heavy rain. Where glyphosate was sprayed over streams higher peak concentrations in water always occurred following heavy rain, up to three weeks after application. Glyphosate residues in stream sediments peaked later and persisted for over a year. The residues were not easily released back into the water however.

Glyphosate is considered slightly toxic to fish, amphibians, aquatic invertebrates, and aquatic plants. The Rodeo® LC₅₀ amounts are >1,000-ppm to fish, 5,407-ppm to amphibians, and 930-ppm to macro-invertebrates. The 2003 Herbicide Information Profile reported the following: "*The likelihood of direct acute toxic effects of glyphosate on aquatic invertebrates or longer term direct effects on any fish species seems extremely remote based on central estimates of the hazard quotient and unlikely base on upper ranges of the hazard quotient. Aquatic plants appear to be somewhat less sensitive to glyphosate than the most sensitive aquatic animals. There is no indication that adverse effects on aquatic plants are plausible*". Glyphosate is not known to bio-accumulate in fish. Also reported was no effect on populations of six species of amphibians (based on capture rates) among clearcuts with and without glyphosate applications. Species included rough-skin newt, *Ensatina*, Pacific giant salamander, Dunn's salamander, western redback salamander, and the red-legged frog. Most of the available toxicity data suggest that amphibians are no more sensitive to glyphosate than fish.

Unlike Round-up®, the aquatic formulations of glyphosate do not contain surfactants. The manufacturer recommends the use of a non-ionic surfactant,

however, to improve the effectiveness of aquatic glyphosate formulations. Surfactant formulations commonly used with aquatic applications in Washington State include LI-700 and Agri-Dex. When considering potential effects to fish from the application of aquatic glyphosate formulations, the toxicity of the surfactant also needs to be considered. The surfactants may be more toxic to aquatic organisms. The 96-hour LC₅₀ of the surfactants proposed for use in this project (LI-700 and Agri-Dex) is 130-mg/L for rainbow trout.

The LI-700 surfactant is a phosphatidycholine compound that is not expected to induce any estrogenic effects (Kelly Kubena, University of Washington, personal communication). Because an aquatic species of concern is likely to be present in any stream, or just downstream of any riparian areas to be treated for crupina, the only herbicide to be used in areas 10-50 feet from water would be the aquatic formulation of glyphosate with the LI-700 or Agri-Dex surfactant. The herbicide would be applied by spraying individual plants with a backpack sprayer so the chemical would not directly enter water.

Picloram is soluble in water and has the potential to leach into groundwater depending on the character of the soil and the weather conditions. Picloram is not to be applied where soils have a rapid to very rapid permeability (such as loamy sand to sand) and the water table is shallow, or where soils contain severely fractured surfaces and substrates that would allow direct introduction to groundwater. Picloram movement is greatest for soils with low organic matter content, alkaline soils, soils that are highly permeable, sandy, or light textured. Sunlight and microorganisms readily break-down picloram and thus it tends not to build-up in the soil. Under favorable conditions, picloram has been found to have a half-life of less than one month, and, under arid conditions, a half-life of greater than four years. Picloram has low toxicity to soil microorganisms.

Picloram is moderately to slightly toxic to freshwater fish and slightly toxic to aquatic invertebrate animals. The acute and chronic toxicity of picloram to aquatic animals has been assayed in various species of trout and *Daphnia magna*, a small aquatic invertebrate. Acute (96-hour) LC₅₀ values for trout range from about 5-mg/L to about 20-mg/L. In *Daphnia*, the reported acute (48-hours) LC₅₀ value is 68-mg/L. Chronic studies using reproductive or developmental parameters for trout and *Daphnia* report no-effect levels of 0.55-mg/L (trout) and 11.8-mg/L (*Daphnia*) and adverse effect levels of 0.88-mg/L (trout) and 18.1-mg/L (*Daphnia*). Thus, it appears that trout are more sensitive than daphnids to both acute and chronic effects of picloram. Based on comparable toxicologic endpoints, it appears that trout are more sensitive to the toxicity of picloram than algae or aquatic invertebrates. Picloram does not bioaccumulate in fish. Neither the published literature nor the RED for picloram includes data regarding the toxicity of picloram to amphibian species. Picloram would not be applied within 50-feet of live streams, rivers, lakes, wetlands, or ditches with standing water, in accordance with EPA requirements identified on the product label and using the mitigation measures identified for this project.

Riparian systems are generally favorable habitat for many plants that would compete with crupina. Alternative C would not cause a noticeable effect on wetlands, riparian areas, or floodplains because the potential occurrence of crupina in these areas would be low, so there would be little herbicide application and little related hand-pulling soil disturbance. Herbicides used in riparian areas or adjacent to wetlands would be the aquatic formulation of glyphosate. This formulation is practically non-toxic to freshwater fish and aquatic invertebrate animals. The label requires a surfactant be applied. Glyphosate would be used in riparian areas with the surfactants LI-700 or Agri-Dex so the effects on fish and invertebrates would be expected to be practically non-toxic.

The effects to fish from hand-pulling and seeding are described in Alternative B. No effects to fish or aquatic species are expected from use of the radiant heat disk.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Use of Motorized Equipment or Mechanical Transport in Wilderness)

Direct and Indirect Effects: Hand-pulling and seeding effects would be the same as for Alternatives B and C. Herbicide effects would be the same as for Alternative C, although there would be about half as much treatment acres under Alternative D. There would be little to no risk of herbicides contacting surface waters.

Cumulative Effects for All Alternatives: The cumulative effects boundary for this analysis is the Prince, Fish and Canoe Creek sub-watersheds, plus two smaller drainages that drain directly into Lake Chelan, eleven years into the future. Current and foreseeable activities in the project area include non-roaded recreation use such as hiking, backpacking, fishing and recreational livestock use on the Lakeshore Trail. Although these activities can add minimal amounts of sediment to Creeks, they are not expected to alter the consequences of manual, mechanical, cultural and chemical treatments on National Forest System land since none of these treatments would contribute much sediment.

- Herbicide treatment could occur on private lands adjacent to the project area in addition to the treatments proposed under the alternatives. It is likely however, that landowners who wish to use herbicides would avail themselves of the opportunity for the Forest Service to do the treatments, and that nothing would be additive to the herbicide treatments proposed in Alternatives C and D. In Alternative B, private landowners who wish to use herbicides could do so without Forest Service involvement and use any formulation allowed by the State of Washington. The Water Resources section later in this chapter modeled the potential for herbicides to enter the creeks and Lake Chelan and determined that no measurable effects to water quality would occur.

The following checklist (**Table 3-7**) displays the effects of the proposed project are expected to maintain riparian and channel conditions within the project area. None of the proposed actions would degrade riparian or channel conditions if implemented as described and mitigated.

Table 3-7. Checklist for documenting the effects of the preferred alternative on aquatic/riparian conditions in the Deer Point Fire Area.

Indicators	Restore ¹	Maintain ²	Degradate ³
WATER QUALITY			
Temperature		X	
Sediment		X	
Contaminants & Nutrients		X	
HABITAT ACCESS			
Physical barriers		X	
HABITAT ELEMENTS			
Substrate Embeddedness		X	
Large Woody Debris		X	
Pool Frequency		X	
Pool Quality		X	
Off-Channel Habitat		NA	
Refugia		X	
CHANNEL CONDITION & DYNAMICS			
Width/Depth Ratio		X	
Streambank Condition		X	
Floodplain Connectivity		X	
FLOW/HYDROLOGY			
Change in Peak/Base Flows		X	
Drainage Network		X	
WATERSHED CONDITIONS			
Road Density & Location		X	
Disturbance History		X	
Riparian Reserves		X	
Disturbance Regime		X	

¹ "restore" means to change the function of an "at risk" indicator to "properly functioning", or to change the function of a "not properly functioning" indicator to "at risk" or "properly functioning" (i.e., it does not apply to "properly functioning" indicators).

² "maintain" means that the function of an indicator does not change (i.e., it applies to all indicators regardless of functional level).

³ "degrade" means to change the function of an indicator for the worse (i.e., it applies to all indicators regardless of functional level). In some cases, a "not properly functioning" indicator may be further worsened, and this should be noted.

Aquatic Conservation Strategy (ACS) Consistency

The ACS was developed to restore and maintain the health of watersheds. The following is a summary of ACS objectives and the rationale for determining project consistency.

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape scale features.

All alternatives avoid potentially degrading actions in riparian reserves (little or no treatment is proposed in riparian reserves).

2. Maintain and restore spatial and temporal connectivity within and between watersheds.

All alternatives would maintain existing aquatic connectivity.

3. Maintain and restore the physical integrity of the aquatic system.

All alternatives avoid potentially degrading actions in riparian reserves. Little or no treatment is proposed in riparian reserves; where treatment occurs, only hand-pulling or spot-application of aquatic glyphosate would be used to minimize impacts to shorelines, banks, and bottom configurations.

4. Maintain and restore water quality to support healthy riparian, aquatic, and wetland resources.

Water quality would be maintained in the No-Action and action Alternatives. All alternatives avoid potentially degrading actions in riparian reserves. Little or no treatment is proposed in riparian reserves; where treatment occurs, only hand-pulling or spot-application of aquatic glyphosate would be used to minimize any impacts on water quality.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved.

North shore landscape and riparian processes evolved under high sediment and sediment delivery regimes. All alternatives minimize potentially degrading actions in riparian reserves. Because crupina is a non-riparian plant, minimal hand-pulling and glyphosate treatment of crupina is proposed in riparian reserves.

6. Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing.

Instream flows sufficient to sustain riparian functions would be maintained under all alternatives. None of the alternatives would have any effect on instream flows.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

None of the alternatives would have any effect on floodplain function.

8. Maintain and restore the species composition and structural diversity of plant communities in riparian reserves to sustain physical complexity and stability.

All alternatives avoid potentially degrading actions in riparian reserves. Little or no treatment is proposed in riparian reserves; where treatment occurs, only hand-pulling or aquatic glyphosate would be used to minimize any impacts to native riparian plants. Riparian restoration would occur to the extent that removal of non-native crupina (however minor) would promote recovery of native species composition.

9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.

All alternatives avoid potentially degrading actions in riparian reserves. Little or no treatment is proposed in riparian reserves; where treatment occurs, only hand-pulling or aquatic glyphosate would be used to minimize impacts to riparian-dependent species. Riparian native plant restoration would occur to the extent that removal of non-native crupina (however minor) would promote recovery of native species composition.

To conclude, the proposed action is consistent with General Riparian Area Management Standard and Guideline RA-3: "Herbicides, insecticides, and other toxicants, and other chemicals shall be applied only in a manner that avoids impacts that retard or prevent attainment of ACS objectives.

Summary Effect Determinations for Fish Species

None of the action alternatives would have any effect on fish habitat suitability and therefore none of the alternatives would contribute to any broad scale trends in Management Indicator Species (cutthroat trout) habitat. Any effects to fish or fish habitat resulting from project activities would be immeasurable in Lake Chelan, so no downstream effects to anadromous fish are expected. Each of the alternatives would have 'no effect' on any Federally-listed fish species.

Section 3.2 – The Physical Environment

This section describes the affected environment and the effects implementation of the alternatives would have on soil and water.

3.2.1 Soil Resources: Affected Environment

Soils and Geomorphology

Alpine glaciation scoured and re-shaped the landscape. Soils in the project area developed from glacial till with subsequent volcanic ash deposition. Following the retreat of the glaciers, volcanic eruptions in Washington and Oregon deposited volcanic ash material over much of the landscape. Some of this ash eroded while other ash deposits remained in place. The volcanic ash on project area slopes tends to erode due to southern aspects. Soils are coarse textured sandy loam to loamy sands. Soils have a low component of clay, with noticeable amounts of gravels, cobbles or stones or bedrock. Bedrock outcrops are common in the area. Soil organic levels are low, with about ¼-inch of material on the surface. Water holding capacity is low in the glacially derived sandy soils. Water holding capacity is better in the ash soils, but where the ash soils have been eroded and are much thinner, water holding capacity moves towards the coarser, glacially derived soils. Soil water permeability ranges from moderately rapid to rapid. Soils are relatively young with poorly defined soil horizons. Organic matter is low on most sites with crupina plants, or the potential for infestation of crupina. When the native vegetation is removed by fire or out-competed by noxious weeds, the sites become hotter and drier. Establishing desirable vegetation is difficult on these harsh sites.

Soil Erosion

Sheep grazing began in the area near the turn of the century and continued into the 1930s and 1940s, followed by horse grazing over much less of the area. Sheep grazing, especially in high use areas, removed vegetation and exposed soil to accelerated rates of erosion from rainfall, rilling, surface creep, and wind erosion. High sheep use areas may still have little to no vegetation especially at the higher elevations pastures in the project area. Horse numbers were fewer and the area grazed was closer to the Lakeshore Trail. Especially at the lower elevations, invading vegetation such as cheatgrass invaded sites disturbed from this grazing. Visits to sites along Lake Chelan infested with crupina in May and June 2002 along the Lakeshore Trail suggest there is no soil compaction remaining from past intense grazing. The coarse textured soils did not show layering that is often associated with compaction in the surface layer.

There is a risk of soil erosion across the project area. About 15% of the project area soils have a slight or moderate erosion risk, about 35% of the area soils have a severe risk of erosion, and the remaining area is covered bedrock outcrops. Generally, areas closer to the lake have the higher erosion risk, with lower erosion risks on upper elevation soils. As crupina invades, desirable native vegetation decreases. Bare soil conditions may occur as crupina out-competes

desired native plants with fibrous root systems. Fibrous root systems tend to hold soil in place better than a single tap rooted plant. The soil with less desirable vegetation erodes at faster rate than soil covered with native vegetation following storm events and from snowmelt runoff that accelerates surface erosion rates. Where crupina is controlled and desirable vegetation is established, soil erosion is reduced. Vegetation cover also slows surface runoff and improves soil porosity and infiltration from root development as Lacey (1989) describes for spotted and diffuse knapweed.

An increase in noxious weed populations has occurred where bare soil conditions exist and growth of grasses and forbs has not occurred. The project area has been through several fires over the past few decades. The fires seem to increase the extent and density of crupina, a persistent competitor that occurs over a range of soil conditions. The fires also increase the soil erosion rate in the burned areas. Increased erosion rates were observed where the fire intensity was the highest. The accelerated erosion rates were the lowest where fire intensity on the soils was low. Fire is a recurring process on these slopes. Fire has affected the vegetation cover and resulting erosion rates. The relatively high fire frequency and resulting increased erosion has stripped all the volcanic ash deposits from the slopes.

Soil and Mycorrhizal Fungi

Numerous researchers, as summarized by Amaranthus and Perry (1988), suggest that mycorrhizal fungi play important roles in plant communities. These roles include: increasing plant nutrient supply by extending the volume of soil accessible to plants; increasing plant growth, nutrient accumulation and/or reproductive success; transferring nutrients from dead to living plants; and contributing to carbon storage in the soil by altering the quality and quantity of soil organic matter.

Amaranthus and Perry (1994) also report that there are important space and time relationships that occur between plants and mycorrhizal fungi in the soil that vary especially during periods of rapid changing above ground community structure and composition, linking old and new stands of vegetation.

3.2.2 Soil Resources: Environmental Consequences

Alternative A (No Action)

Direct and Indirect Effects: Under this alternative field crews would not disturb the soil resource. Soil erosion would stabilize at higher levels than currently exist as crupina competes successfully with more desirable vegetation and occupies sites. The poorly developed tap-root on crupina plants retards less soil movement than the fibrous root system of most native plants. This would result in less vegetative cover, allowing higher erosion rates.

Since weeds are not often associated with development of mycorrhizal fungi there would be no change in the levels in the soil where crupina is currently established. Areas currently covered with desirable native plants would have lower levels of mycorrhizal fungi if replaced by crupina. Reduced levels of mycorrhizal fungi would make it more difficult for desirable plants to reinvade soils because the desirable plant roots would not be able to access as much of the soil for nutrients and water (which was aided by the presence of mycorrhizal fungi). There would be a reduction in the organic matter incorporated into the soil, which would reduce soil structure, water holding capacity and nutrient capitol, also making it more difficult for desirable plants to out-compete the crupina and eventually re-occupy the site.

Cumulative Effects: The cumulative effects boundary for soils is the treatment areas within the project area 11-years into the future (10-years of treatment, plus one extra year for the half-life of picloram). Ongoing and foreseeable future actions include recreational use of trails, boat landings and campsites, trail maintenance, recreational livestock grazing, weed treatment on private land, and wildfire and fire suppression.

Private lands have crupina infestations and may be treated by manual, mechanical, or chemical methods. These lands were included in **Table 3-8** (in **Appendix E**) that show accelerated erosion. The cumulative chemical use on private lands is not expected to affect mycorrhizal fungi or soil nutrient status. There may be repeated applications of herbicides on private lands. Herbicides used in accordance with their label would not tend to bioaccumulate in the soil. Accelerated soil erosion over background levels would be expected on private land where roads were constructed or soil excavation was associated with home building. Amounts are small, less than one ton per year in the North Shore watershed area, compared with background levels of about 9,570-tons per year.

Where use is intense and native vegetation is destroyed, mycorrhizal development would be disrupted and soil erosion would increase. Maintenance of trails is generally limited to down tree removal and treadwork of cleaning out drainage dips, fixing broken-down drainage dips, and removal of rocks, roots, or other obstructions for safe travel. Any ground-disturbing work would be limited to the trail or immediately adjacent to it. A slight increase in erosion would occur where crupina dominates the site, although the soil would be retained in existing downslope buffers.

Alternative B (Only Hand-pulling Used)

Direct and Indirect Effects: Hand-pulling crupina would not likely affect mycorrhizal fungi since weeds are not often associated with the development of the mycorrhizal relationships (see soils affected environment). Under this alternative hand-pulling crews would disturb soil. The trampling and exposure would lead to increased erosion by soil creep, raindrop impact, and rilling.

Further increase in weed spread would contribute to soil erosion. Some soil erosion would continue on crupina-infested sites, compared to sites covered with desirable vegetation, from precipitation events where there is less vegetative protection of the soil surface. Accelerated soil erosion would contribute sediment to nearby stream channels. Compared to the background level, erosion would increase 0-8% until vegetation is established on treated areas (1-2 years). Soil compaction would not occur on the glacial till soils. If the areas with volcanic ash soils were wet or moist, slight soil compaction would occur especially where work crews were concentrating travel to and from the worksites. This would reduce the soil water infiltration rate on the compacted soils, but untreated areas adjacent to the compacted soils would take any additional runoff, so there would not be any net change in surface runoff into the streams or Lake Chelan.

Seeding of treated areas to prevent the return of crupina and to help reduce erosion would maintain soil depth. Manual seed application would cause slight soil displacement from the foot traffic. No soil erosion would occur from seeding because the amount of displaced soil would be small.

Cumulative Effects: The cumulative effects boundary for soils is the treatment areas within the project area 11-years into the future (10-years of treatment, plus one extra year for the half-life of picloram). Ongoing and foreseeable future actions include recreational use of trails, boat landings and campsites, trail maintenance, recreational livestock grazing, weed treatment on private land, and wildfire and fire suppression.

Hikers and/or recreational livestock would not increase soil erosion or impacts to mycorrhizal fungi along the trail generated, since the traffic would be confined to the maintained trail. The numbers of livestock leaving the trail is small in the historically crupina infested areas. Concern about crupina spreading from the Lakeshore Trail corridor, would focus treatment priorities.

Trail maintenance is generally limited to down tree removal and treadwork of cleaning out drainage dips, fixing broken-down drainage dips, and removal of rocks, roots, or other obstructions for safe travel. Any ground-disturbing work would be limited to the trail or immediately adjacent to it. Increased sedimentation to surface water is rare and not expected. A slight increase in erosion would occur where crupina dominates the site, although the soil would be retained in existing downslope buffers.

Private lands have crupina infestations and may be treated by manual, mechanical, cultural, or chemical methods. It is likely, however, that property owners would accept the opportunity to have the Forest Service hand-pull weeds under this alternative. Erosion from these lands would add less than one ton to the estimated 10,300-tons from the north shore watershed. There may be several applications of herbicides on small areas within the private lands. Herbicides used in accordance with the label would not tend to bioaccumulate in

the soil. Chemical use on private lands is not expected to affect mycorrhizal fungi or soil nutrient status.

Burned areas from future wildfires where crupina persists would support the germination of dormant crupina seed. Fireline construction from fire suppression activities may increase soil erosion.

Herbicide Effects Common to Alternatives C and D

Herbicide persistence in and on the soil surface depends on soil characteristics. High amounts of clay and organic carbon and low pH increase herbicide adsorptions. Soils in the project area are low in clay content, low in organic carbon and have neutral or slightly acidic pH conditions that limit adsorption. In general, warm temperature, equitable moisture, and neutral pH give the fastest conditions for breakdown of herbicides (Frank, n.d.). Formulation and use of herbicides can also affect persistence. Granular formulations are most persistent followed in decreasing order by emulsions, mixable liquids, and wettable powders (Hance, 1982). The crupina project would use the liquid form of both glyphosate and picloram.

Prather, Callihan, and Thill (1991) report picloram is the best treatment when only one application is made per year. Picloram remains active in soil for about 18-months. The half-life of picloram is reported to vary from one month under favorable environmental conditions, to more than four years in arid regions. Breakdown caused by sunlight and microorganisms in the soil are the main ways picloram degrades in the environment. Long-term build-up of picloram in the soil generally does not occur and dissipation occurs more quickly in warm, wet weather. Picloram application would be avoided during wet periods since saturated soil conditions accelerate the leaching of the herbicide. Picloram has low toxicity to soil microorganisms at up to 1,000-parts per million. Picloram is active in the soil and can pass from soil to growing plants; it can also move through roots of treated plants to nearby plants (USDA, 2000).

Glyphosate is absorbed into the plant through the foliage but is not absorbed from the soil by plant roots. Glyphosate is adsorbed firmly to soil particles, so there is little movement through the soil. Glyphosate remains unchanged in the soil for varying lengths of time, depending on soil texture and organic matter content. The half-life of glyphosate in soil ranges from 3 to 249-days. Some formulations of glyphosate require the addition of a surfactant that reduces the surface tension of liquids. It is added to improve herbicide performance by increasing plant absorption. The safety of surfactants varies for aquatic organisms, so the choice of a surfactant would depend on the aquatic organisms to be protected. This choice gives the greatest flexibility in the use of glyphosate near water. An approved surfactant would be used with glyphosate to meet label application requirements. Soil microorganisms break down both glyphosate and surfactants. Most studies have shown no adverse effects of glyphosate on soil

microorganisms, including soil nitrogen cycling processes, though contact may injure or kill non-target plants.

Picloram may leach through sandy soils when there is excess moisture to fill soil pores and gravitational water movement occurs. The gravitational force that pulls water through soil pores depends on the slope gradient and how long there is sufficient water for saturated flow. Soil texture is important; it determines the relative size of soil pore spaces. Coarse textured soils have relatively large pores, while fine textured soils have small pores. The larger pore spaces would allow more rapid saturated flow rates, than small pore spaces with saturated flow. Soils with larger soil pores would also drain more quickly, and in the absence of adequate soil moisture (to fill soil pores) would have saturated flow conditions for a shorter time.

Movement of glyphosate is not likely through the soil profile because the relative strong adsorption of the herbicide to particles. Bakke (2001) summarizes several monitoring reports on glyphosate and found only one sample with a relatively low detection out of 104-samples. Bakke recommended no further monitoring for glyphosate outside riparian areas. The detected level in the positive sample was below any level of concern for human health or aquatic resources.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct and Indirect Effects: This alternative would use manual, mechanical, cultural, and chemical treatments on current infested sites and potential crupina habitat. The accelerated soil erosion rate would increase 0-4% (see **Table 3-8**, in **Appendix E**).

Work crews would disturb soil where manual and mechanical treatments are used. The soil trampling and exposure would lead to increased erosion by soil creep, raindrop impact, and rilling. Further increase in weed spread would contribute to soil erosion. Some soil erosion would continue on crupina-infested sites, compared to sites covered with desirable vegetation, from precipitation events where there is less vegetative protection of the soil surface. Accelerated soil erosion would contribute sediment to nearby stream channels. Compared to the background level, erosion would increase 0-4% until vegetation is established on the treated areas. Soil compaction would not occur on the glacial till soils. If the areas with volcanic ash soils were wet or moist, slight soil compaction would occur where work crews concentrate travel to and from worksites. This would reduce the soil water infiltration rate on the compacted soils, but untreated areas adjacent to the compacted soils would absorb added runoff, so there would not be any net change in surface runoff into streams or Lake Chelan.

Seeding of treated areas to prevent the return of crupina and to help reduce erosion would have no effects on soil properties. Slight soil displacement from the foot traffic would occur as seed is applied. No effects on soil erosion would occur because the amount displaced would be small.

Heat disk treatment of crupina would not have any effect on soil properties since the soil temperature would not be raised to high levels and the heat would not destroy soil organic matter.

Chemical use would include the herbicides picloram and glyphosate. Picloram may exist at levels toxic to plants for more than one year after application at normal rates. The maximum label rate is 2 pints per acre. Application rates are expected to be 1-2 pints per acre, depending on stage of crupina development. Project area soils contain little organic matter and picloram can be translocated through the soil. Movement is dependent on the hydraulic conductivity of the soil, slope gradient, and the amount of soil pore space (the hydrology effects section discusses potential ground water movement of picloram). The maximum distance picloram is expected to move in the soil is about 16-feet. Sunlight and microorganisms in the soil would cause picloram breakdown with carbon dioxide as the main by-product of picloram breakdown in soil. The small amount of carbon dioxide produced is not likely to be harmful to the soil or the environment (USDA, 2000).

At application rates higher than is planned for the proposed action, picloram may inhibit microbial activity (USDA, 2000). In a worst-case scenario, Tu (1994) showed a relatively high level of picloram caused a short-term decrease of nitrification after two weeks. The decrease was relatively mild and does not suggest a substantial or prolonged impact on microbial activity. USDA (2003a) noted that certain metabolites from the breakdown of picloram were found in plants, but did not accumulate in the soil. No effects on soil properties would occur because picloram would be applied at recommended or lower rates.

Carbon dioxide is the major end-product of picloram breakdown in the soil. Carbon dioxide is a gas normally found in the air. The relatively small amount of carbon dioxide produced when picloram degrades in soil is not likely to be harmful to the environment. A study regarding the breakdown of picloram in soil identifies two compounds produced in minor amounts: 4-amino-3,5-dichloro-6-hydroxy-picolinic acid and 4-amino-2,3,5-trichloro-pyridine. These metabolites also were found in plants exposed to picloram. According to the study, the compounds are not part of the major metabolic pathway for picloram in soil and do not accumulate in soil (USDA, 2000). The main breakdown product of glyphosate in soil is AMPA (aminomethylphosphonic acid), which is broken down further by soil microorganisms.

Glyphosate would be used within 50-feet of water bodies and no closer than 10-feet to water. Most studies show no adverse effects on soil microorganisms, including soil nitrogen cycling processes. Monitoring of pine seedlings and associated mycorrhizal fungi found no effect on seedling growth or ectomycorrhizal development from glyphosate use (USDA, 1997). No effects on soil properties would occur because glyphosate would be applied at the recommended or lower rates.

Staging using a helicopter is not expected to cause any soil compaction because the helicopter would only be allowed to land at existing landings or clearings; no new landings would be constructed.

Cumulative Effects: The cumulative effects boundary for soils is the treatment areas within the project area 11-years into the future (10-years of treatment, plus one extra year for the half-life of picloram). Ongoing and foreseeable future actions include recreational use of trails, boat landings and campsites, trail maintenance, recreational livestock grazing, weed treatment on private land, and wildfire and fire suppression.

Hikers and/or recreational livestock would not increase soil erosion or impacts to mycorrhizal fungi along the trail generated, since the traffic would be confined to the maintained trail. The numbers of livestock leaving the trail is small in the historically cripina infested areas. Concern about cripina spreading from the Lakeshore Trail corridor, would focus treatment priorities.

Trail maintenance is generally limited to down tree removal and treadwork of cleaning out drainage dips, fixing broken-down drainage dips, and removal of rocks, roots, or other obstructions for safe travel. Any ground-disturbing work would be limited to the trail or immediately adjacent to it. Increased sedimentation to surface water is rare and not expected. A slight increase in erosion would occur where cripina dominates the site, although the soil would be retained in existing downslope buffers.

Private lands have cripina infestations and may be treated by manual, mechanical, cultural, or chemical methods. It is likely, however, that property owners would accept the opportunity to have the Forest Service treat cripina with various methods under this alternative. Erosion from these lands would add less than one ton to the estimated 9,900-tons from the north shore watershed. There may be several applications of herbicide by the landowners on small areas. Herbicides used in accordance with their label would not tend to bioaccumulate in the soil. Chemical use on private lands is not expected to affect mycorrhizal fungi or soil nutrient status.

Burned areas from future wildfires where cripina persists would support the germination of dormant cripina seed. Fireline construction from fire suppression activities may increase soil erosion. On combustion, as might occur in a wildfire

following treatment, picloram is converted to 2,3,5-trichloro-4-aminopyridine (4A-TCP). 4A-TCP is also found in plant and soil decomposition, and is generally more toxic than picloram to microorganisms. There is no information about the toxicity of 4A-TCP to mammals. At 900°C, picloram decomposes to carbon dioxide, carbon monoxide, chlorine gas, hydrogen chloride, and ammonia. Organo-chlorines are not identified as combustion products of picloram. By-products from burning plants treated with picloram were not identified in the field (USDA, 2000). Major products from burning treated vegetation include phosphorus pentoxide, acetonitrile, carbon dioxide, and water. Phosphorous pentoxide forms phosphoric acid in the presence of water. Since picloram itself has a half-life of around 18-months, the application area and amounts are small considering the scale of the landscape, and more than 95% of picloram residue is destroyed during burning, the likelihood of synergistic effects from these compounds is small. These compounds are not known to be a human health hazard at levels found in a vegetation fire (USDA, 1997).

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Motorized Equipment or Mechanical Transport in Wilderness)

Direct and Indirect Effects: Hand-pulling is the major treatment proposed. Soil erosion rates would increase 0-8% compared to background levels. Under this alternative, where manual and mechanical treatments are used, field crews would disturb the soil. The trampling and exposure would lead to increased erosion by soil creep, raindrop impact, and rilling. Further increase in weed spread would contribute to soil erosion. Some soil erosion from precipitation events would continue on crupina-infested sites (compared to sites covered with desirable vegetation) where there is less vegetative protection of the soil surface. Accelerated soil erosion would contribute sediment to nearby stream channels. Compared to the background level, erosion would increase 0-8% until vegetation became reestablished on the treated areas. Soil compaction would not occur on the glacial till soils. If the areas with volcanic ash soils were wet or moist, slight soil compaction would occur especially where work crews were concentrating travel to and from the worksites. This would reduce the soil water infiltration rate on the compacted soils, but untreated areas adjacent to the compacted soils would take any additional runoff, so there would not be any net change in surface runoff into the streams or Lake Chelan.

Heat disk treatment of crupina would not have any effect on soil properties because soil temperature would not be raised to ignition levels and the heat would not destroy soil organic matter.

In this alternative, about 50-acres of combined private and National Forest System lands would be treated with herbicides. Effects of herbicides for crupina treatment would be similar to those disclosed above with Alternative C on less

acreage. The area within wilderness would be limited to those locations readily accessible by foot.

Removal of crupina plants would not likely affect the mycorrhizal fungi since weeds are not often associated with the development of plant/mycorrhizal relationships (see affected environment section above).

Staging using a helicopter is not expected to cause any soil compaction because the helicopter would only be allowed to land at existing landings or clearings; no new landings would be constructed.

Cumulative Effects: The cumulative effects boundary for soils is the treatment areas within the project area 11-years into the future (10-years of treatment, plus one extra year for the half-life of picloram). Ongoing and foreseeable future actions include recreational use of trails, boat landings and campsites, trail maintenance, recreational livestock grazing, weed treatment on private land, and wildfire and fire suppression. Cumulative effects disclosures for this alternative would be the same as Alternative C except on less acreage.

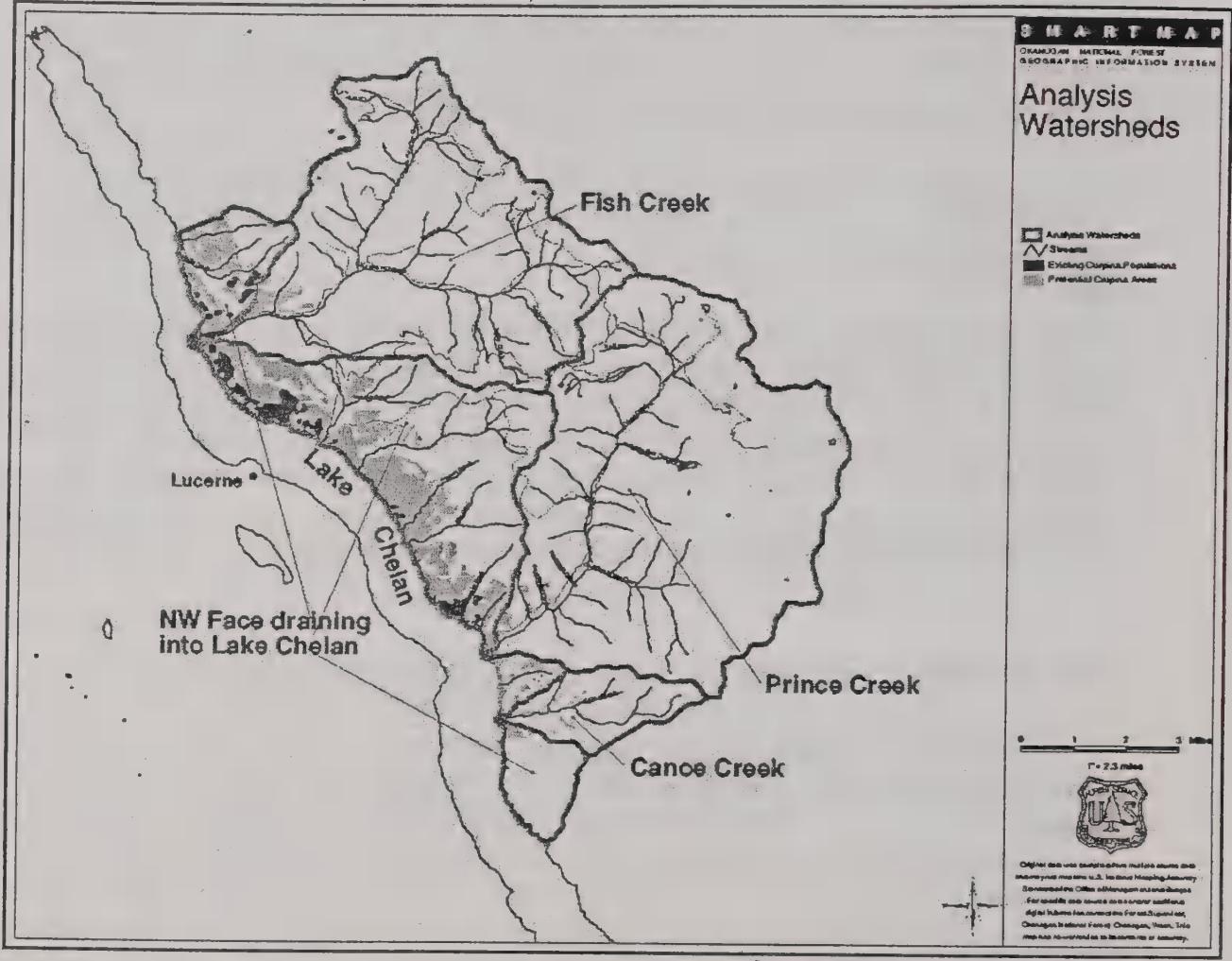
3.2.3 Water Resources: Affected Environment

The project area contains about 155-miles of streams. Fish, Prince, and Canoe Creeks drain into the northwest side of Lake Chelan (see **Figure 3-1**). The largest drainages are Fish and Prince Creeks with surface runoff characterized by snow melt peak flow usually in May or June, annually falling to low flow during August and September. Winter stream flow is lower and often limited due to freezing. Slopes that drain directly into Lake Chelan, and into the lower reaches of Fish, Prince, and Canoe Creeks have intermittent streams weakly incised with peak flows in April and often dry by June. These streams may have peak flows immediately following thunderstorms.

Due to the 2001 Rex Creek fire, peak streamflow would be expected to occur slightly sooner and peak slightly higher than the recent pre-burn period due to reduced tree cover. Without ground cover that slowed runoff from snowmelt or high intensity precipitation, there is an increased risk of flooding or the sudden release of water from behind recently accumulated debris. Canoe Creek also has an increased risk of debris failures inside the watershed because the vegetation was burned from the shallow, rocky soils. The high percentage of exposed bedrock and shallow soils retain little water. The slope gradients are steep, and debris failures could flow all the way to Lake Chelan.

Precipitation on the project area is 35-50 inches per year (Gladwell and Mueller, 1967), although precipitation at the highest elevations of the watersheds is about 45-inches. About 50-75% of the precipitation falls as snow during the late fall and winter months, with July, August, and September the driest months.

Figure 3-1. Analysis Area Watersheds in the Crupina Project Area (includes historic and potential crupina habitat).



As discussed by Patmont *et. al.* (1989), Lake Chelan is divided into the Lucerne and Wapato Basins. The crupina project area is within the influence of the larger Lucerne Basin. The basin has a maximum depth of nearly 1,500-feet, contains about 92% of the total lake volume, and is about 40-miles long. Tributaries originating in the forested and glaciated mountains feed the basin. Water flowing into the basin will reside there for about 10-years. The down-lake Wapato Basin begins just above Manson and continues to the lake outlet just below the town of Chelan. The Wapato Basin is about 12-miles long and is shallower with a maximum water depth of about 400-feet. With less overall volume, water residence period is about nine months. The Wapato Basin has most of the land development and water quality is most affected by land use here.

Water quality is high in Lake Chelan adjacent to the project area. Most water quality information, however, is for the lower end of Lake Chelan. The 1998 Washington State 303(d) impaired water bodies contains listings in lower Lake Chelan basin for pesticides (4,4'-DDE) and PCBs. There are no specific 303(d) listings for the upper end of Lake Chelan. Seasonal elevated water temperature during low stream flow is a normal occurrence in perennial streams (not in Lake Chelan) throughout the project analysis area due to south facing slopes and scattered vegetation on the drier slopes.

Water use from Lake Chelan includes irrigation, domestic, recreational, livestock watering, mining, and industrial, most of this occurring in the Wapato Basin. Substantial recreation water use occurs on National Forest System lands while most consumptive uses do not.

Noxious weeds can contribute to impacts on water quality. Slightly higher erosion rates occur where noxious weeds with poorly developed roots such as crupina have replaced existing vegetation. Where there is inadequate native plant ground cover because of noxious weed infestations, especially near streams, slightly higher sediment loads may occur.

Because some existing patches of crupina and potential treatment areas are near streams or Lake Chelan, the proximity to water is important. Herbicides used on sites near water increases the risk of water contamination. Careless application of herbicides and resulting drift near water could contaminate Lake Chelan, surface streams, or shallow groundwater. Increased surface erosion following mechanical or manual methods of weed control would occur because the ground disturbance detaches soil particles and removes vegetation that protected the soils from raindrop splash erosion. When these areas are near streams or Lake Chelan increased stream sedimentation could occur, depending on the distance and slope gradient. **Table 3-9** shows potential treatment acres within 50-feet of streams or Lake Chelan.

Table 3-9. Potential Crupina Treatment Areas within 50-Feet of Water by Watershed.

Watershed	Acres Within 50 Feet of Streams or Lake Chelan
Fish Creek	20
Prince Creek	21
Canoe Creek	13
Lake Chelan North Shore	146

Riparian areas and floodplains include transition areas between aquatic and upland areas with distinct vegetation and hydrologic characteristics. The only project area floodplains are near the mouth of Fish and Prince Creeks. Wetland areas have unique soils, hydrology, and vegetation characteristics and provide important hydrologic function. There are about 121-acres of wetlands and

riparian reserves in the project area watersheds. These areas are important for storing, filtering, and releasing water; impacts to the ability of these areas to absorb, store, and release water can affect water quality and quantity off-site.

3.2.4 Water Resources: Environmental Consequences

Alternative A (No Action)

Direct and Indirect Effects: There would be no risk of herbicides from National Forest lands reaching Lake Chelan or the project area streams tributary to the Lake. There would be no impacts on the 303(d) listed parameters in Lake Chelan. Riparian systems are generally favorable habitat for plants that compete with crupina. Potential impacts of increased stream sedimentation to water quality would be limited since crupina is not likely to invade the areas near streams. Native plant competition in the riparian areas would limit infestations of crupina within 50-feet of streams. Alternative A would not cause a noticeable effect on wetlands, riparian areas or floodplains because the amount of crupina plants in riparian areas would be low since native vegetation has a competitive advantage.

Cumulative Effects: The cumulative effects boundary for water resources includes the Prince, Fish, and Canoe Creek watersheds along with two smaller watersheds that directly drain into Lake Chelan, 11-years into the future (10-years of treatment, plus an extra year for the half life of picloram). Ongoing and foreseeable future actions include recreational use of trails, boat landings campsites, trail maintenance, recreational livestock grazing, weed treatment on private land, and wildfire and fire suppression. Recreational activities generally would increase the risk of spreading crupina seed outside the current infestation area. Future wildfires and attendant fire suppression activities would increase soil erosion and stream sedimentation especially when fireline is adjacent to streams. Burned areas would have higher erosion rates especially in the short-term and contribute as well to stream sedimentation.

Sheep use occurred many years ago in the analysis area watershed, though most use was outside the past or present crupina treatment areas or the potential crupina habitat areas. In the upper portions of the watersheds, impacts are still evident from past sheep grazing. Past grazing impacts include breakdown of stream banks in high use areas and decreased ground cover in bedding or gathering areas. In areas that have not been grazed the past 50-60 years, recovery is underway.

In addition to National Forest System lands, adjacent private lands have crupina populations. Private landowners may use herbicides, mechanical, or manual methods to control crupina. Herbicides other than those available for use on national forest system lands may be used on private lands. In the late 1980s, 2, 4-D and Banvil® were used to spray crupina on private lands. There are about

160-acres of private land inside the project area with historical infestations. If 0.25-pounds of 2, 4-D were applied on 25% of the private lands (see direct and indirect effects discussion, Alternative C), about 10-pounds of herbicide would be applied. If this were applied 200-feet from Lake Chelan, about 0.01-pounds would drift to Lake Chelan. This amount would not be detectable in Lake Chelan. If the 10-pounds were applied along the edge of Lake Chelan, about 0.02-pounds would drift to Lake Chelan. This amount would also be undetectable in Lake Chelan. When herbicides are applied according to label instructions and restrictions, drift and ground water movement of leachable herbicides would not be detectable in Lake Chelan. All the private lands (162-acres of historical crupina infestations) are in the north shore watershed area draining directly into Lake Chelan. However, under this alternative, no herbicides would be used on National Forest System lands, so no cumulative effects from herbicide use would occur.

Water use in Lake Chelan, Prince Creek, and Fish Creek by recreationists would not be affected by treating crupina populations in this alternative. Boating and fishing would continue with no restrictions from this project. Since no detectable levels of herbicide in surface water would occur from proper use of herbicides by private landowners if label instructions are followed, water use would continue with no restrictions from this project.

Alternative B (Only Hand-pulling Used)

Direct and Indirect Effects: As with Alternative A, without chemical applications, there is no risk of herbicides getting into the water. Potential impacts of increased stream sedimentation to water quality from manual weed control methods would be increased soil disturbance from foot traffic of work crews and the hand pulling operation. Accelerated erosion would occur, and where the hand-pulled areas are adjacent to streams, additional sedimentation in the stream would occur. At the current time, the established infestations of crupina are limited to a few acres within 50-feet of streams. Seeding as a follow-up to crupina treatment would minimize potential erosion.

The water bodies on the Washington State 303(d) list are down-lake of the project area, but there would not be any impacts on listed parameters in the lower Lake Chelan basin. Hand-pulling and seeding would not add 4,4-DDEs or PCBs to Lake Chelan or other surface or sub-surface waters so there is no change in the down lake concentrations of these compounds. Alternative B would not cause a noticeable effect on wetlands, riparian areas or floodplains because the potential number of crupina plants in these areas would be low, so there would be little activity and related disturbance. Native plant competition in the riparian areas would limit crupina infestations.

The Forest Service would hand-pull with follow-up seeding on private lands based on the crupina treatment priorities established in Chapter 2 if private

landowners are agreeable. Effects on private lands would be similar to those described above for National Forest System lands.

Cumulative Effects: The cumulative effects boundary for water resources is the Prince, Fish, and Canoe Creek watersheds along with two smaller watersheds that directly drain into Lake Chelan, 11-years into the future (10-years of treatment, plus an extra year for the half life of picloram). Ongoing and foreseeable future actions include recreational use of trails, boat landings campsites, trail maintenance, recreational livestock grazing, weed treatment on private land, and wildfire and fire suppression. Recreational activities generally would increase the risk of spreading crupina seed outside the current infestation area. Future wildfires and attendant fire suppression activities would increase soil erosion and stream sedimentation especially when fireline is adjacent to streams. Burned areas would have higher erosion rates especially in the short-term and contribute as well to stream sedimentation.

Sheep use occurred many years ago in the analysis watersheds, although most use was outside the past and present crupina treatment areas or the potential crupina habitat areas. In the upper portions of the watersheds, impacts are still evident from past sheep grazing. Past grazing impacts include breakdown of stream banks in high use areas and decreased ground cover in bedding or gathering areas. This increased stream sedimentation during grazing, and the additional sediment was transported through the stream system. Some of the sediment was deposited in lower stream reaches, but most reached Lake Chelan and was deposited on the lake bottom.

In addition to the crupina that would be hand-pulled under this alternative either on either private or National Forest System land, landowners may use herbicides, mechanical, or manual methods to control crupina plants. Herbicides other than those available for use on National Forest System lands may be used on private lands. In the late 1980s 2, 4-D and Banvil® were sprayed on crupina on private lands. There are about 160-acres of private land inside the project area with historical infestations. If 0.25 pounds of 2, 4-D were applied on 25% of the private lands (see direct and indirect effects discussion, Alternative C), about 10-pounds of herbicide would be applied. If this were applied 200-feet from Lake Chelan, about 0.01-pounds would drift to Lake Chelan. This amount would not be detectable in Lake Chelan. If the 10-pounds were applied along the edge of Lake Chelan, about 0.02-pounds would drift to Lake Chelan. This amount would also be undetectable in Lake Chelan. When herbicides are applied according to label instructions and restrictions, drift and ground water movement of leachable herbicides would not be expected to be detectable in Lake Chelan. All the private lands (162-acres of historical crupina infestations) are in the North Shore analysis watershed area draining directly into Lake Chelan. However, no herbicides would be used on National Forest System lands, so no cumulative effects from herbicide use would occur.

Water use by recreationists in Lake Chelan, Prince Creek, or Fish Creek would not be affected by treating crupina in this alternative. Boating and fishing would continue with no restrictions. Since no detectable levels of herbicide in surface water would occur, water use would continue with no restrictions.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct and Indirect Effects: Any liquid herbicide sprayed on target vegetation would fall on foliage and surrounding soil. The fate and transport of herbicides include these potential transfer and degradation processes: absorption and detoxification by plants; photo-degradation by sunlight; volatilization; adsorption or adhesion to soil particles and organic matter; chemical degradation; microbial degradation; solubilization and dilution in surface runoff; and leaching through the soil horizon and potentially to groundwater. How much each process occurs depends on several factors, including weather conditions (e.g., precipitation, sunlight, and wind); soil conditions (e.g., thickness, permeability, organic matter content, pH, temperature, moisture content); slope gradient; depth to groundwater; and chemical characteristics of herbicides. While no detectable levels of herbicides are expected in surface or ground water because of the relatively small amount of herbicides applied, if any measurable herbicide concentrations did occur, these would be short-term and limited to areas in close proximity to the treatment areas due to dilution and degradation of the chemicals in soil and water.

The herbicide picloram has a high solubility in water that increases the potential for leaching into groundwater and transport across buffers. Picloram would not be sprayed directly on water, banks, or wetlands such as swamps, bogs, or marshes (USDA, 2000). The aquatic formulation of glyphosate would be used to minimize impacts to water and aquatic species. Glyphosate adsorbs to soil particles (USDA, 1997) and is likely to remain where applied, unless the soil is eroded.

Herbicides can get into water through drift, direct application into surface water, ground water seepage related to a surface water source, and erosion of soil sprayed with herbicides. Potential drift and surface water contamination is evaluated with the AGDRIFT® model (Teske, et. al., 2002). Ground water movement is evaluated using site factors and the Darcy equation for saturated-soil water movement. Soil erosion was evaluated with the Universal Soil Loss Equation (Darrach et. al., 1978).

Annual crupina treatments of up to 200-acres would be covered under this alternative. Herbicides would be used on about half of the area. In addition, crupina that invades the 4,500-acres of potential crupina habitat could be treated with herbicide. Follow-up work would include hand-pulling and herbicide applications on persistent infestations. This analysis considers the potential drift

distance from backpack-operated, ground spraying of herbicides and potential shallow ground water movement of herbicides under saturated soil conditions. Seeding of treated areas where little native vegetation remains (herbicide, mechanical and hand-pulled areas) would occur following control work to minimize erosion and reduce potential for re-invasion by weeds. The Okanogan and Wenatchee National Forest Noxious Weed Prevention Strategy (OWNF, 2002) would be used to prevent or minimize the spread of crupina or other noxious weed infestations outside of non-infested areas or back into the successfully treated areas, while providing vegetative competition inside the treated sites.

The AGDRIFT® model was used to estimate potential drift and the concentration of the drift at distances up to 1,000-feet from the application location. The model uses a spray height of 20-inches for the ground application of the herbicide. In reality, hand application of herbicide would be a few inches above the plant to actually touching the sprayed plant, so the results from the model would tend to overestimate the drift potential. At 50-feet, the model estimates about 0.00005% of the initial application would drift to at least that distance. In a worst-case application of 192-pounds (based on 400-acres at 2-pints per acre) of picloram would result in about 0.01-pounds of the active ingredient drifting 50-feet. At 1,000-feet, the same application would result in about 0.004-pounds of active ingredient drifting.

AGDRIFT® estimates that the projected drift levels would be undetectable in Lake Chelan. Wind speed and relative humidity would also influence the amount of drift. Wind would disperse the drift further, although the relatively short distance from the nozzle to the plant when the herbicide is sprayed would reduce the drift distance. Low relative humidity would tend to reduce droplet size and increase the potential drift distance. The short distance between crupina plant and the point of application reduces the time the droplets could evaporate and reduce in size. Specifications for the application of herbicides according to wind speed, air temperature, and relative humidity would generate drift at levels projected by AGDRIFT® (see also mitigation measures for herbicide treatment, chapter 2).

Ground water movement of picloram was modeled with the Darcy Ground Water Movement Model (<http://md.usgs.gov/toolbox/gw/ws2220.html>). The model estimates groundwater flow rates under saturated conditions. This is the most rapid rate of ground water movement. Flow rates in unsaturated soil conditions occur much slower and are not meaningful for this analysis. Saturated flow conditions occur for about 5-days each year, and picloram has a half-life that varies from 1-month to 4-years (USDA, 2000). For this analysis picloram was assumed active in the soil over two growing seasons. Saturated soils such as when snow is actively melting and soil pores are full would only exist for a few days each year on sites that would be sprayed with picloram. Heavy rainstorms over 1-2 days may bring the soil to saturated conditions, but only as long as the

heavy rains persist. This analysis considered two scenarios over a two-year period. The first situation is 5-days of saturated flow per year for a total of 10-days over two years, and the second situation uses conservative modeling assumptions of 15-days a year of saturated soil conditions for a total of 30-days over two growing seasons. **Table 3-10** shows the estimated saturated soil water movement over 10-and 30-days for various slopes. Since picloram would be applied on crupina plants greater than 50-feet away from surface water, it would not get to surface water in saturated soil conditions during the average half-life period.

Table 3-10. Estimated Distance of Picloram Movement by Slope Gradient.

	Days of Saturated Soil Conditions Over Two Growing Seasons	
	10	30
Slope Gradient	Distance (feet)	
5	0.4	1.1
25	1.7	5.0
50	3.6	10.9
75	5.3	16.0

Riparian systems are generally favorable habitat for many native plants that would compete with crupina. Alternative C would not cause a noticeable effect on wetlands, riparian areas, or floodplains because the potential number of crupina plants in these areas would be low, so there would be little herbicide application, little hand-pulling soil disturbance, and no herbicide treatment within 10-feet of these areas. The aquatic formulation of glyphosate would be used in riparian areas or adjacent to wetlands. This formulation is practically non-toxic to freshwater fish and aquatic invertebrates. The label requires a surfactant and the glyphosate herbicide information profile (USDA, 1997) includes R-11, LI-700, and Agri-Dex. LI-700 and Agri-Dex are classified practically non-toxic to both fish and invertebrates. In riparian areas, glyphosate with surfactants LI-700 or Agri-Dex would be used so the effects on fish and invertebrates would be minimal. Although glyphosate is soluble in water, it loses herbicide properties on contact with soil. It is not absorbed from the soil by plant roots. The potential for glyphosate leaching into ground water is low, because the herbicide is strongly adsorbed to soil particles and is not easily released back to water moving through the soil.

In addition to National Forest System lands, adjacent private land is infested with crupina. With landowner permission and cooperation, the Forest Service would use herbicides, mechanical, or manual methods to control crupina in accordance with the treatment criteria and mitigation presented in Chapter 2 of this EIS. Herbicides would be those available for use on National Forest System lands. There are about 160-acres of private land inside the project area with historical infestations. A total of about 40-pounds of picloram would be applied at a rate of 0.25-pounds per acre on the private land (see direct and indirect effects discussion above). If this were applied 200-feet from Lake Chelan, about 0.04-pounds would drift to Lake Chelan. This amount would not be detectable in Lake

Chelan. If the 40-pounds were applied along the edge of Lake Chelan, about 0.08-pounds would drift to Lake Chelan. These quantities when added to those estimated for application to National Forest System lands would still be undetectable in Lake Chelan when applied according to label instructions and restrictions. All the private land (162-acres with crupina infestations) is in the north shore watershed that drains directly into Lake Chelan.

The effects of hand-pulling, heat disk treatment, and seeding under this alternative are the same as those discussed in Alternative B direct and indirect effects.

The water bodies on the Washington State 303(d) list are down-lake of the project area and there would not be any impacts on listed parameters in the lower Lake Chelan basin. The use of the planned herbicides with the design criteria and mitigation measures in Chapter 2 would result in no measurable amounts of herbicides in Lake Chelan. Hand-pulling, herbicides, seeding, or heat disk treatment would not add any 4, 4-DDEs or PCBs to Lake Chelan or other surface or subsurface waters so there would be no change in the down-lake concentrations of these compounds. Alternative C would not cause a noticeable effect on wetlands, riparian areas, or floodplains because the potential number of crupina plants in these areas would be low and no treatment would occur within 10-feet of water. Native plant competition in the riparian areas would also limit crupina infestations. There would be little weed treatment activity and related disturbance.

Cumulative Effects: The cumulative effects boundary for water resources is the Prince, Fish, and Canoe Creek watersheds and two smaller watersheds that directly drain into Lake Chelan, 11-years into the future (10-years of treatment, plus an extra year for the half life of picloram). Ongoing and foreseeable future actions include recreational use of trails, boat landings campsites, trail maintenance, recreational livestock grazing, weed treatment on private land, and wildfire and fire suppression. Recreational activities generally would increase the risk of spreading crupina seed outside the current infestation area, though the risk would be neutralized with the implementation of crupina treatment methods in this alternative. Future wildfires and attendant fire suppression activities would increase soil erosion and stream sedimentation especially when fireline is adjacent to streams. Burned areas would have higher erosion rates especially in the short-term and contribute as well to stream sedimentation.

Sheep use occurred many years ago in the analysis area, though most use was outside the crupina treatment areas or the potential crupina habitat areas. In the upper portions of the watersheds, impacts are still evident from past sheep grazing. Past grazing impacts include breakdown of stream banks in high use areas and decreased ground cover in bedding or gathering areas. Streams transported the added sediment for deposit in lower stream reaches and Lake Chelan.

Landowners could choose to treat private lands with herbicides other than those used by the Forest Service. The effects of such treatment are the same as described under the cumulative effects for Alternative B.

Water use in Lake Chelan, Prince Creek, and Fish Creek by recreationists would not be affected by treating crupina with this alternative. Boating and fishing would continue with no restrictions. Since no detectable levels of herbicide in surface water would occur, water use would continue with no restrictions.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Motorized Equipment or Mechanical Transport in Wilderness)

Direct and Indirect Effects: With limited hand application of herbicides on National Forest System lands, there is little to no risk of herbicides getting into the water resources. Where herbicides are applied, the potential distance of herbicide movement would be similar to those described in Alternative C and Table 3-10.

Potential impacts of increased stream sedimentation to water quality from manual weed control methods would be increased soil disturbance from foot traffic of work crews and the hand pulling operation. Accelerated erosion would occur, and where the hand-pulled areas are adjacent to streams, additional sedimentation in the stream would occur. At the current time, the established infestations of crupina are limited to a few acres within 50 feet of streams. Less site disturbance (compared to hand-pulling) would occur from heat disk treatments or seeding of treated sites because there would fewer people crossing the slopes. No additional stream sedimentation would occur from these operations.

The water bodies on the Washington State 303(d) list are down-lake of the project area and there would not be any impacts on listed parameters in the lower Lake Chelan basin. The use of herbicides with the treatment criteria and mitigation measures in Chapter 2 would result in no measurable amounts in Lake Chelan. Hand-pulling, herbicides, seeding, or heat disk treatments would not add any 4,4-DDEs or PCBs to Lake Chelan or other surface or sub-surface waters so there is no change in down-lake concentrations of these compounds. Alternative D would not cause a noticeable effect on wetlands, riparian areas, or floodplains because the potential number of crupina plants in these areas would be low. No treatment would occur within 10-feet of water, so there would be little activity and related disturbance. Native plant competition in the riparian areas would also limit crupina infestations.

The AGDRIFT® model estimates about 0.00005% of the initial application would drift 50-feet. Using conservative modeling assumptions, 24-pounds of picloram (total area of 50-acres at 2-pints per acre of picloram) would result in about

0.0012-pounds of active ingredient drifting 50-feet. AGDRIFT® estimates that the projected drift levels would be undetectable in Lake Chelan. Because fewer acres would be treated in Alternative D, effects of potential drift would be less than in Alternative C.

In addition to the National Forest System land treated, adjacent private land is infested with crupina. With permission and cooperation, the Forest Service would use herbicides, mechanical or manual methods to treat crupina on private land in accordance with the treatment criteria and mitigation measures presented in Chapter 2 of this EIS. Herbicides would be those available for use on National Forest System land. There are about 160-acres of private land inside the project area with crupina infestations. A total of about 40-pounds of picloram would be applied at a rate of 0.25-pounds per acre on the private land (see direct and indirect effects discussion above). If this were applied 200-feet from Lake Chelan, about 0.04-pounds would drift to Lake Chelan. This amount would not be detectable in Lake Chelan. If the 40-pounds were applied along the edge of Lake Chelan, about 0.08-pounds would drift to Lake Chelan. These quantities when added to those estimated for application to National Forest System lands would still be undetectable in Lake Chelan when applied according to label instructions and restrictions. All the private land (162-acres with crupina infestations) is in the north shore watershed that drains directly into Lake Chelan.

Alternative D would have seeding following hand-pulling, radiant heat disk, and herbicide treatments. The effects would be slightly lower soil erosion rates until adjacent vegetation occupies treated sites. This would decrease the risk for more erosion and resulting stream sedimentation for until the treated sites are occupied by adjacent vegetation.

Cumulative Effects: The cumulative effects boundary for water resources is the Prince, Fish, and Canoe Creek watersheds along with two smaller watersheds that directly drain into Lake Chelan, 11-years into the future (10-years of treatment, plus an extra year for the half life of picloram). Ongoing and foreseeable future actions include recreational use of trails, boat landings campsites, trail maintenance, recreational livestock grazing, weed treatment on private land, and wildfire and fire suppression. Recreational activities generally would increase the risk of spreading crupina seed outside the current infestation area, though the risk would be neutralized with the implementation of crupina treatment methods in this alternative. Compared with Alternative C the risk of spread is slightly greater for this alternative since less crupina acreage would be effectively treated. Future wildfires and attendant fire suppression activities would increase soil erosion and stream sedimentation especially when fireline is adjacent to streams. Burned areas would have higher erosion rates especially in the short-term and contribute as well to stream sedimentation. Sheep use occurred many years ago in the analysis watersheds, although most use was outside the historical crupina treatment areas or the potential crupina habitat areas. In the upper portions of the watersheds, impacts are still evident.

from past sheep grazing. Past grazing impacts include breakdown of stream banks in high use areas and decreased ground cover in bedding or gathering areas. Streams transported the added sediment for deposit in lower stream reaches and Lake Chelan.

Private landowners could choose to treat crupina with herbicides other than those used by the Forest Service. The effects of such treatment are the same as described under the cumulative effects for Alternative B.

Water use in Lake Chelan, Prince Creek, and Fish Creek by recreationists would not be affected by treating crupina in this alternative. Boating and fishing would continue with no restrictions. Since no detectable levels of herbicide in surface water would occur, water use would continue with no restrictions.

Section 3.3 – The Human Environment

This section describes the affected environment and the effects alternative implementation would have on the human health and safety, wilderness, recreation, scenery, and heritage resources.

3.3.1 Human Health and Safety: Affected Environment

The project area is steep, rocky, uneven terrain that is difficult to access. Substantial physical exertion is required to traverse the project area. Rocky areas can harbor rattlesnakes. No herbicides use has occurred on National Forest System lands previously, so no residual herbicide would be present either in the soil or on vegetation. Herbicides have been used on adjacent private land to treat weeds.

3.3.2 Human Health and Safety: Environmental Consequences

Alternative A (No Action)

Direct and Indirect Effects: Under Alternative A, crupina and other weeds would continue to spread in the project area and beyond. This would impact individuals affected by allergies and minor skin irritations caused by certain noxious weed species. Potential for public exposure to herbicides sprayed on National Forest System lands under Alternative A is eliminated since no herbicides would be used.

Cumulative Effects: The cumulative effects boundary would be the project area for the next eleven years (10-years of implementation plus an extra year to account for the half-life of picloram). It is foreseeable that manual, mechanical, cultural, or chemical weed control would be used on private land. Herbicides used on private lands may or may not be those discussed in this EIS. Private landowners can use herbicides approved for use by the EPA and the Washington State Department of Agriculture. The range of available herbicides would be larger and the herbicide selected for use on private lands would be based on landowner preference. Exposure would be limited to those landowners who live on or visit the land where the work is done. Public exposure would be limited to areas where the Lakeshore Trail passes through private land if the landowner uses herbicides. A slight exposure might occur where National Forest System lands are adjacent to sprayed private land. Herbicide treatments would be expected to occur infrequently on private lands, only once or twice per growing season. There would not be daily exposures to herbicides. No adverse health effects are anticipated for the public based on limited exposure or estimates of herbicide drift.

Alternative B (Only Hand-pulling Used)

Direct and Indirect Effects: Hand pulling and seeding would occur on National Forest System lands and adjacent private land where adjacent property owners agree to treatment. The project area contains steep, rocky, and uneven terrain. Crews are generally on their hands and knees while pulling weeds, crab-walking up slopes to ensure that no plants are missed. Hand-pulling crews carry large bags that may cause balance difficulties when returning to staging areas.

Potential human health risks for workers and the public from manual and cultural control methods are minor. The risk to workers may include cuts, falls, burns, allergies, and skin irritation from contact with plants during hand-pulling. Human health effects would be greatest to persons with allergies or contact dermatitis who are sensitive to invasive weeds or other vegetation. Knapweed intermixed with crupina at a few locations may cause minor scrapes and irritations. About 10 to 15-percent of the population suffers from allergy symptoms from weeds such as knapweed. Allergies may complicate or trigger asthma. Potential human health risks associated with post-treatment seeding (cultural methods) include exposure to dust and chaff during seed application.

While there is some potential for health effects associated with manual and cultural treatments of weeds, safety instruction, personal protective equipment (PPE) such as gloves, long-sleeved shirts, boots, and safety glasses, along with personal hygiene, would prevent injuries or irritations. Although rattlesnakes are present in the project area, places with high potential rattlesnake habitat would be left untreated. Overall, human health effects are not anticipated with manual weed removal or cultural seeding.

Cumulative Effects: The affected area would be the project area for the next eleven years (10-years of implementation plus an extra year to account for half-life of picloram). Chemical and manual control could occur on private lands, as discussed in Alternative A. Those effects from the private lands would be the same in Alternative B. No adverse health effects are anticipated for the public based on limited exposure or estimates of herbicide drift in Alternative B.

General Effects Information Common for the Use of Herbicides in Alternatives C and D

The following literature was used to analyze potential human health risks associated with ground application of herbicides. 1).Herbicide profiles for picloram and glyphosate developed for the Forest Service specifically to summarize effects that include human health. 2) Risk assessments completed by the Forest Service under contract with Syracuse Environmental Research Associates (SERA) for picloram and glyphosate (USDA, 1997 and 2000). The risk assessments were recently revised to include the most current information.

Label restrictions on herbicides are developed to mitigate, reduce, or eliminate potential risks to humans and the environment. Label information includes: personal protective equipment; user safety; first aid; environmental hazards; directions for use; storage and disposal; general information; mixing and application methods; approved uses; weeds controlled; and application rates.

Analysis of herbicide use in this EIS assumes compliance with the product label during handling and application. Additional environmental protection measures listed in mitigation in Chapter 2 are typically developed by resource specialists to further reduce potential risks to human health and the environment during application of herbicides. These measures are implemented during application to ensure mitigation is greater than required by EPA-approved label requirements.

Factors Affecting Hazard of Herbicide Method of Application

How herbicides are applied can have a direct impact on the potential for human health effects. According to risk assessments completed on herbicide usage on forested lands (USDA, 1997 and 2000), the persons that apply herbicides are at a higher risk to human health than the public. The risk assessments compared risks to workers for all types of application, including aerial, backpack, ground-mechanical, and hand applications. Lower risks were estimated for aerial and ground mechanical application as compared to other methods, even though the total amount of herbicide applied in a given day was higher. Risks associated with backpack and hand application of herbicides were estimated to be the highest, due to workers being closer to the nozzle and from transferring liquid formulations to backpack containers. Backpack and hand application was also reported to increase the likelihood of a worker receiving repeated exposures that may remain on the skin for an extended amount of time. The EPA (1995), in the re-registration of picloram, also noted that the highest risk was for those using the backpack application method, the lowest for aerial and ground applicators.

Length of Exposure

The dosage that is hazardous to health depends on whether a single dose is given all at once (acute exposure); multiple doses are given over longer periods (chronic exposure); or, regular repeated doses or exposures over periods ranging from several days to months (sub-chronic). The EPA developed Reference Doses (RfDs), which are an estimate of a daily dose over a 70-year life span that a human can receive without an appreciable risk of deleterious effects (EPA, 2003b). RfDs include a "safety factor" where the No Observable Effect Level (NOEL) is divided by a factor, usually 100, to account for uncertainty and hypersensitive individuals. The figure 100 is derived by including a safety margin of 10 for extrapolating study results from mammals to humans, and an additional safety factor of 10 for variation in population response to a particular compound.

The RfD is a conservative toxicological threshold in relation to this analysis because it assumes daily exposure over a 70-year life span, and because the RfD is calculated from the No-Observed-Effect-Level (NOEL), assuming humans are 100-times more sensitive than animals (uncertainty factor of 100). Actual environmental exposures for herbicide treatments in this project would typically be a few days each year for about 10-years.

Potential doses to workers or the public from application of herbicides would be transitory. Lifetime RfDs are used here as a convenient and conservative comparison for determining significance of human doses. Lifetime RfDs values are based on daily feeding studies, whereas workers and the public would not be exposed daily over a lifetime. Maximum duration of exposure for workers on a yearly basis was estimated in the range of 10 to 40-days for commercial applicators (EPA, 1995).

Route of Exposure

Substances tested for acute toxicity are usually administered pumping a chemical down a tube into the stomach of animals. From this route of exposure, an oral LD-50 (lethal dose that kills 50-percent of a test population, measured in milligram of herbicide per kilogram of animal weight) can be estimated.

Exposure during chronic testing usually involves placing the chemical in the animal food, and then measuring the amount of food eaten during each 24-hour period (EPA, 1998, 2002a).

Test substances are also applied to the shaved skin of an animal to estimate a dermal LD-50. About 10-percent of the body surface of the animal is exposed to a chemical covered by a patch for 24-hours. In acute exposure studies, whether by oral or dermal routes, animals are monitored for a range of adverse responses for 14-days following dosing (EPA, 1998).

Skin acts as a protective barrier to limit and slow down movement of a chemical into the body. Studies of pesticides applied to the skin of humans indicate that for many only about 10-percent or less passes into the blood. In contrast, absorption of chemicals from the small intestine is quicker and more complete than from the skin (Ross *et. al.*, 2000). For this reason, dermal LD-50s are usually much higher than oral LD-50s. A person can tolerate greater doses of a substance without becoming sick when exposure is through skin contact rather than through ingestion (Hayes, 1991).

Test organisms are also administered substances in the air to estimate an inhalation LD-50. In this case, exposure units are expressed as milligrams of test substance per unit of volume (usually a liter of air, which is equivalent to 0.035-cubic feet). The onset of illness can occur more quickly by inhalation exposure than by oral or dermal contact due to rapid entry of the substance into the blood stream. However, studies with pesticide applicators (who receive higher

exposures than the general public) indicate dermal exposures are greater than inhalation exposures (Ross *et. al.*, 2000).

Toxicity of Herbicides

A comparison of toxicity for typical herbicides is shown in **Table 3-11**. Toxicological studies using animals typically involve purposeful exposure to dosages required to cause an effect (i.e. tumors, changes in immunity, etc.), or to establish a Lowest Observed Effect Level (LOEL) or a No-Observed-Effect-Level (NOEL). This often requires administration of relatively high doses of a chemical in order to document an effect or lack thereof. The causal dose in many toxicological studies is significantly greater than what an applicator might be exposed to while applying herbicides or the public may be exposed to walking through a treated field or living adjacent to treated land. Therefore, concluding that an applicator may experience neurological effects because a study in rats showed such connection, may lead to an erroneous conclusion because the dose administered to the rat is in no way representative to what an applicator may be exposed to when applying a herbicide. In addition, the method of exposure to herbicides in animal studies is uniquely different than that of a worker or the public, possibly leading to a causal effect. In animal studies, herbicides are commonly pumped into stomachs (gavage), put directly into food, or placed directly on shaved skin. Herbicide applicators and the public are clothed and do not purposely ingest herbicides under the same conditions as animal studies of toxicological significance.

Table 3-11. Comparison of Herbicide Toxicity

Herbicide	Estimated Exposure to Public (2)	RfD (mg/kg/day)	Mutagenic and Reproductive	Carcinogenic (1)	Acute oral LD50 for rats (mg/kg/day)
glyphosate	<RfD	0.1	No	E	2,000 - 6,000
picloram	<RfD	0.2	No	E	3,000 - 5,000

RfD = Reference Dose; No = No Observable Effect Level; Units expressed as milligrams of herbicide per kilogram of body weight = mg/kg; LD50 = lethal dose in milligram of herbicide per kilogram of animal weight that kills 50 percent of a test population.

¹ EPA carcinogenicity classification based on daily consumption for a 70-year life span. D = Not Classifiable as to Human Carcinogenicity; E = Evidence of Non-Carcinogenicity

² Exposures under typical exposure scenarios. Accidental and extreme exposure scenarios may exceed the RfD. Sources: Infoventures, 1995a,b; OSU, 1996a,b; USDA, 1997b, 2003c,d.

Estimates of exposure to workers and the public of herbicides applied to forests have been reported under various conservative exposure scenarios (USDA, 2003a and 1997a). The most reasonable interpretation of the risks associated with application of most herbicides on forest lands is that, except for accidental exposures or extremely atypical and perhaps implausible exposures scenarios (i.e. acute direct spray entirely covering a naked child), the use of herbicides on forest lands would not pose an identifiable risk to workers or the public.

Exposures under typical exposure scenarios (those following guidelines on the label) would be below the reference dose (RfD), a dose level determined to be safe by the EPA over a lifetime of daily exposure.

USDA (2003b) reported there is no evidence that typical exposures to picloram would lead to a dose level that exceeds the RfD or level of concern with the exception of wearing contaminated gloves for one hour, which results in estimates of absorbed doses that exceed the RfD.

Acute Toxicity

Acute toxicity is measured by the LD-50, defined as the dosage of toxicant expressed in milligrams per kilogram of body weight, which is lethal to 50-percent of animals in a test population within 14-days of administration (EPA, 1998, 2002). Since potential exposure levels to workers and the public associated with use of herbicides on Forest land have been estimated to be at or below EPA reference doses (RfDs), dosages would not exceed acute toxicity dose levels when applying herbicides on forest land.

Sub-Chronic and Chronic Toxicity

There is considerable information on sub-chronic and chronic effects due to exposure to herbicides in controlled animal studies. The information suggests that the herbicides proposed for use are not carcinogenic, and there is no evidence to suggest that the herbicides proposed for use would result in carcinogenic, mutagenic, teratogenic, neurological, or reproductive effects based on anticipated exposure levels to workers and the public (Arbuckle, 1999; Charles, 1996; Faustini 1996; Mattsson, 1997; Infoventures, 1995a, b; OSU, 1996 a, b; and USDA, 2003a, b, 1997a, and 2001).

Synergistic Interactions

Concerns are occasionally raised about potential synergistic interactions of herbicides with other herbicides in the environment. Synergism is a special type of interaction in which the combined impact of two or more herbicides is greater than the impact predicted by adding the individual effects. These include the interaction of the active ingredients in an herbicide formulation with its inert ingredients, the interactions of these herbicides with other herbicides in the environment, and the cumulative impacts of spraying as proposed with other herbicide spraying to which the public might be exposed.

No one can guarantee the absence of a synergistic interaction between herbicides and/or other chemicals to which workers or the public might be exposed. For example, exposure to benzene, a known carcinogen that comprises 1 to 5-percent of automobile fuel and 2.5-percent of automobile exhaust, followed by exposure to any of these herbicides could result in unexpected biochemical interactions (USDA, 1997c). Analysis of the infinite number of materials a person may ingest or be exposed to in combination with chemicals is outside the scope of this analysis. There is some indication

however, that the co-exposure to 2, 4-D and picloram may induce effects not associated with exposure to 2, 4-D or picloram alone (USDA, 2001; Cox, 1998; OSU, 1996a). 2, 4-D may be used on private land adjacent to National Forest System land, but would not be used on public land.

Impurities, Adjuvants, and Inert ingredients in Herbicide Formulations

During commercial synthesis of some pesticides, by-products can be produced and carry over into the product eventually formulated for sale. Occasionally by-products or impurities are considered toxicologically hazardous, and concentrations must be limited so that potential exposures do not exceed levels of concern (Felsot, 2001).

Technical grade picloram contains hexachlorobenzene (HCB) as a by-product of the synthesis of the active ingredients (USDA FS, 1999). HCB is also a by-product of chlorinated solvents used extensively in industry and occasionally around the home. HCB was registered as a fungicide until banned by US EPA over concerns that it may be carcinogenic. As a result, EPA has imposed a limit of 100-parts per million (ppm) HCB in Tordon®. The manufacturer of Tordon® reportedly maintains HCB levels in formulated picloram at 50-ppm or less (i.e. 50-milligrams per liter of formulation). Average concentrations of HCB in picloram have been estimated at 8-ppm (EPA, 1995). Therefore, HCB comprises only 0.000005-percent of the Tordon® formulation, which is then further diluted by a factor of 350 when the spray solution is prepared.

Given the dilution of formulations by water in the final spray solution, estimates of HCB exposure from use of picloram have shown resulting residues in the environment and exposure levels to bystanders do not exceed current background levels. The central estimates of worker exposure under normal conditions to HCB were estimated to be lower than the background levels of exposure by factors of about 1,000. Likewise, the exposure assessments based on the use of picloram have been estimated to result in long-term estimates for the general public that are below the estimated background doses of HCB due to environmental contamination by factors of about 1,400 to seven million (USDA, 2003b). Thus, for commercially sold products which are more dilute than technical grade products, there appears to be no basis for asserting that the use of picloram in accordance with the label would cause substantial increases in the general exposure of either workers or members of the general public to HCB.

The proprietary nature of herbicide formulations limits the understanding of risks posed by inerts and adjuvants in herbicide formulations. Unless the EPA classifies a compound hazardous, the manufacturer is not required to disclose identity. It could be suggested that the inerts in these herbicides are not toxic, or the toxicity would be reported to the EPA. This would hold true if considerable toxicological testing of inerts has been done. That, however, has not been the case. EPA is increasing the testing requirements for inerts, but in many cases the inerts currently in use have not been tested rigorously and toxicity is not well

characterized. That being said, studies on the toxicity of technical grade formulations, which often contain the inerts, account for the toxicity of the inerts, and as has been reported here, these studies show that the use of herbicides would not expose workers or the public to levels of concern.

The literature does report considerable information on the types of inerts and adjuvants present in the herbicides proposed for use. Both Tordon® 22 and 22K contain the potassium salt of picloram (24.4%), with the rest consisting of polyglycol 26-2, the registered name for polyethylene glycol, a widely used family of surfactants considered to have low toxicity and frequently used in the formulation of ointments and cosmetics. Glyphosate has been reported to contain small amounts of nitrosamine, and N-nitroglyphosate (USDA, 2003a).

Many herbicide formulations contain dyes, and the use of dyes can be beneficial in that they can color vegetation, making it less likely for individuals to inadvertently or intentionally contact or consume contaminated vegetation. The presence of a dye in herbicide formulations also makes it easier for workers to avoid missing areas or spraying areas twice. It also allows identification of contamination and prompt remedial action.

Dyes may also pose risks to humans and wildlife. The most common dyes used with herbicides are Milori blue, Heliogen blue, Lithol rubine, and Sico fast orange (USDA, 1997b). Little information is available on the toxicity of the majority of dyes used in the industry. There has been considerable concern over the carcinogenic potential of less used dyes Rhodamine B and Basic Violet 3.

Surfactants are also commonly used in herbicide formulations. Surfactants are added to herbicides to improve herbicide mixing and the absorption or permeation of the herbicide into the plant. Like dyes and other inerts, there is limited information on the types of surfactants used and the toxicity of surfactants, especially since the industry considers the surfactant to play a key role in the effectiveness of the herbicide formulations. Most knowledge of surfactants is proprietary information, and not disclosed. The glyphosate herbicide profile (USDA, 1997), assessed the effects of surfactant formulations on the toxicity of glyphosate, reporting that the toxicity of glyphosate alone was about the same as the toxicity of the glyphosate and surfactant mixer and greater than the toxicity of the surfactant alone. Whether this same pattern would hold true of picloram with the same or different surfactants is unknown. If so, the toxicological studies performed on herbicide formulations (which contain the inerts and surfactants) may accurately portray the toxicity and risks posed to humans by the surfactant.

Endocrine System Interactions

The endocrine system includes tissues and hormones that regulate metabolism, growth, and sexual development. The Food Quality Protection Act (FQPA) requires that EPA develop tests to screen for chemicals with the potential to

mimic hormones. Chemicals that do mimic hormones and cause biochemical changes in tissues are called endocrine disrupters or hormonally active agents (HAAs).

The concern over HAAs is due to the endocrine system being intimately linked with the brain and the immune system. All three systems communicate to affect body development and functioning. Adverse effects on this network have been blamed for a variety of maladies ranging from cancer to infertility to behavioral problems (Felsot, 2001).

Chemicals, other than hormones, can interact with components of the endocrine system. Scientists have discovered that many kinds of chemicals, including natural food biochemicals, as well as industrial chemicals and a few pesticides, can mimic the action of the hormones estrogen or testosterone. Concern has also been expressed about potential effects on the thyroid hormone during early development (Felsot, 2001).

Two general types of tests are used to screen chemicals for the ability to disrupt the endocrine system. *In-vitro* tests are most widely used. These are conducted in a test tube or dish using cells and in some cases the protein receptors, enzymes, and genes involved in the biochemistry of the endocrine system. *In-vitro* tests can be used to quickly screen large numbers of chemicals for the ability to interact with different biochemical components of the endocrine system.

Positive *in-vitro* tests, however, do not necessarily indicate that a substance would actually disrupt hormone functioning in a whole organism. *In-vitro* screening tests are properly used to determine which chemicals should be subjected to a second type of test, the *in-vivo* or "live animal" test. *In-vivo* tests use whole animals that are fed various doses of chemical. In some cases, the chemical is injected beneath the skin or directly into the body cavity. Developmental and reproductive toxicity studies with live animals over several generations are especially useful for determining if a substance adversely affects the endocrine system.

Studies do not indicate any general basis for glyphosate to disrupt the endocrine system however this herbicide has not undergone an extensive evaluation for the potential to interact or interfere with estrogen, androgen, or thyroid hormones. Thus, the potential endocrine effects of glyphosate can be overly interpreted (USDA, 2003a). Picloram also has not been tested for activity as an agonist or antagonist of major hormone systems. Inferences concerning the potential effect of picloram on endocrine function must be based on inferences from standard toxicity studies. A two-generation reproduction study of picloram (potassium salt) in CD rats reported no endocrine effects at doses as high as 1,000-mg/kg/day. Endocrine effect endpoints examined in this study included reproductive outcomes, histopathological examination of tissue. Of the other studies reviewed

in the picloram risk assessment (USDA, 2003b), no evidence was found for this herbicide to produce direct endocrine system effects.

With one exception, the drug DES (diethylstilbestrol), all chemicals that have been tested *in-vitro* are thousands to millions of times less potent than the natural estrogen hormone (estradiol) (Felsot, 2001). Also, as exhibited by estradiol, all chemicals tested *in-vitro* appear to show definitive threshold effects (*i.e.*, NOELs) for estrogenic activity. No pesticides, food biochemicals, or other synthetic chemicals have definitively shown greater and/or different *in-vitro* effects at low doses as compared to higher doses. Although natural hormones function at very minuscule levels in the body, endocrine disrupter tests have shown that interactions of hormone receptors with natural and synthetic chemicals are still related to dose during exposure.

In the *in-vivo* (live animal) studies to date, only a handful of chemicals, including natural food biochemicals, a few pesticides, and several industrial chemicals show endocrine disrupting effects (Felsot, 2001). The *in-vivo* experiments usually involve feeding pregnant rats or mice one or more doses of a chemical. Because the male fetus is more vulnerable to estrogen mimics than females, they are studied for any effects on prostate glands, penile malformations, and sperm production. With one exception, the drug DES, any effects that have been observed were in tests with doses greater than environmental or dietary concentrations.

In virtually all published cases where a series of doses are tested *in-vivo*, endocrine effects did not occur below some threshold dose. The EPA (1997) concluded with few exceptions (*e.g.* diethylstilbestrol) that a causal relationship between exposure to a specific environmental agent and an adverse effect on human health operating via an endocrine disruption mechanism has not been established.

Uncertainty

With the exception of accidental exposures or exposures under conservative scenarios, workers and the general public would not be exposed to a herbicide at concentrations that result in an adverse health effects. This conclusion is predicated on applicators wearing appropriate PPE and applying herbicides following label instructions (see mitigation measures Ch. 2). By doing so, possible exposure by contact or through drift would result in a dose below that determined to be safe by the EPA over a lifetime of daily exposure. It is also predicated on the findings, supported by toxicological studies, that a person can be exposed to some amount of a contaminant and not have an adverse effect (*i.e.* the dose determines the effect).

All of the herbicides proposed for use must be registered for use by the EPA and the USDA. Registration of these herbicides and Federal regulations adopted to protect workers and the public has required more scientific information and

justification for use of herbicides. Nevertheless, there are reports in the scientific literature and various sections of this report that document associations between chemical exposures and alterations of the immune system, autoimmune disorders, and increases in the probability of carcinogenesis (Citron, 1995; Glover-Kerkvliet, 1995). The literature raises concerns about additive and synergistic effects of exposure to more than one herbicide, unstudied or unknown consequences of low-level chronic exposures, toxicity of inerts, by-products, or contaminants of herbicides, and uncertainties about the health effects of sensitive populations. There is also the realization that it is difficult, if not impossible, for government or any scientific agency to fully evaluate a chemical and all potential combinations to ensure there would not be an adverse effect.

Herbicide use to control noxious weeds is not without risk. All chemical exposure results in some level of health risk, the risk primarily being a function of the dose, or amount a person or organism is exposed to over time. However, the same literature that raises concern over health effects also reports effects occur at doses significantly higher than that expected through use of herbicides. The estimated dose of each herbicide that a worker or public person may be exposed to through use of the herbicide would be below that determined to be safe by the EPA for a lifetime of daily exposure. Therefore, no health effects and risks to workers and the public are anticipated by the use of herbicides.

Herbicide Drift Dynamics

Spray drift is largely a function of droplet particle size, release height, and wind speed (Teske and Thistle, 1999). The largest particles, being the heaviest, will fall to the ground sooner than smaller sizes upon exiting the sprayer. Medium size particles can be carried beyond the sprayer swath (the fan-shape spray under a nozzle), but all particles will deposit within a short distance of the release point. There will always be a small percentage of spray droplets small enough to be carried in wind currents to varying distances beyond the target area. Because the small droplets are a minor proportion of the total spray volume, the significance beyond the field boundary rapidly declines as dilution occurs in increasing volumes of air (Felsot, 2001).

Drift characteristics differ between herbicides. With one of the two herbicides proposed, it is not critical to coat the entire leaf. Plant roots can absorb picloram, and larger droplets on leaves of the target plant can achieve good efficacy. Therefore, herbicide drift can be reduced with larger droplets without reducing efficacy.

Spray nozzle diameter, pressure, amount of water in the spray mixture, and release height of the spray are important controllable determinants of drift potential by virtue of the influence on the spectrum of droplet sizes emitted from the nozzles (Felsot, 2001; Teske and Thistle, 1999). Meteorological conditions such as wind speed and direction, air mass stability, temperature and humidity and herbicide volatility also affect drift.

Wind speed increases the concentration of drifting droplets leaving the treated area if the wind is adverse (blowing away from the release point in the treatment area). If the wind is favorable, blowing into the treatment area, drift can be reduced. Applications would be made when wind speed is less than 10 mph blowing away from sensitive areas. This restriction combined with no-spray buffers adjacent to sensitive areas would likely result in no off-site drift in concentrations above EPA established "safe" levels.

Chemically Sensitive Individuals

A small percentage of the population may have a hypersensitivity to herbicides proposed for use. These people are generally aware of this sensitivity and would not be allowed to work on herbicide spray crews or in treated areas until either safe re-entry periods, or a period adequate based on personal knowledge of the sensitivity, has passed. Safe re-entry periods where herbicides have been applied are determined by the herbicide label restrictions.

Herbicide metabolites/degradation products

Carbon dioxide is the major end-product of picloram in soil. This gas is common and the relatively small amount produced when picloram degrades is not likely to be harmful to the environment. One study regarding picloram breakdown identifies two metabolites, 4-amino-3, 5-dichloro-6-hydroxy-picolinic acid and 4-amino-2, 3, 5-trichlor-pyridine, produced in minor amounts. These compounds were found in plants exposed to picloram however, are not part of the major metabolic pathway for picloram in soil and do not accumulate in soil. The main product of glyphosate in soil is AMPA (aminomethylphosphonic acid), which is further broken down by soil micro-organisms.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct and Indirect Effects: This alternative would utilize hand-pulling, heated disks, seeding and herbicides on National Forest System lands, and adjacent private lands where landowners agree to treatment. Potential risks for workers and the visitors to the area would be the greatest with Alternative C. While risks to human health are greatest under this alternative, the effects would be below a level considered safe by the EPA for the herbicides proposed. Where herbicides are used, treatment would be done with backpack sprayers. Backpack applications have the greatest potential for worker exposure to herbicides (see Human Health, Affected Environment section). The length of time for applications needed to treat the areas would also be the longest of all alternatives, and would increase worker exposure. Backpack sprayers can treat about one acre per day on rugged, steep, and remote terrain. Treatment would require applications of about 100-worker-days in the spring. The duration of applications would depend on the number of applicators. Fewer workers would increase the exposure per worker and longer application periods would increase the chance of the public

encountering a spray operation. The application period would be longer in Alternative C with more treatment acres than Alternative D.

Handling and mixing of the herbicides and more work in close proximity to the spray nozzle would increase exposure and subsequent health risk to the worker. The more time spent applying herbicides increases the risk of a spill, accident, or mishap. Risk of herbicide spills or accidents would be greatest under Alternative C. The public may be secondarily exposed to a spill or release should a spill reach surface or groundwater. This potential effect would be minimized by the mitigation to only mix backpack sprayers outside of riparian areas. The indirect effects in the form of public exposure would correspond with the proximity of the spill to the public.

Alternative C includes manual and cultural treatments similar to those disclosed in Alternative B.

For mechanical treatment methods, potential human health risks associated with use of radiant heat disks include falls from carrying equipment that would have a tendency to raise the applicator center of gravity, propane leaks, burns from direct contact with the heated disk, and inadvertently starting a fire with the heated disk. To minimize the risk of falls, applicators will be required to carry propane tanks and application wands securely over uneven ground. Applicators will be instructed in listening and smelling for potential gas leaks, and avoiding direct contact with the heating element by keeping the torch pointed at the ground. Additionally, heat disks will not be used early in the treatment season and in areas with low risk of contact with large patches of dry plant material that might ignite a fire. Gloves, long-sleeved shirts, boots, and other PPE as needed would prevent injuries. Human health effects are not anticipated from mechanical treatments.

Cumulative Effects

The cumulative effects boundary would include the project area for the next eleven years (10-years of implementation plus an extra year to account for the half-life of picloram). Because this alternative includes manual, mechanical, cultural, and chemical treatment on private lands where landowners agree, it is unlikely that landowners would act alone in treating crupina.

Burned areas from future wildfires where crupina persists would support the germination of dormant crupina seed. Fireline construction from fire suppression activities may increase soil erosion. The burning of vegetation treated with picloram may result in the formation of combustion products that may pose a health risk. On combustion, as might occur in a wildfire following treatment, picloram is converted to 2, 3, 5-trichloro-4-aminopyridine (4A-TCP). 4A-TCP is also found in plant and soil decomposition, and is generally more toxic than picloram to microorganisms. There is no information about the toxicity of 4A-TCP to mammals. At 900°C, picloram decomposes to carbon dioxide, carbon

monoxide, chlorine gas, hydrogen chloride, and ammonia. Organo-chlorines are not identified as combustion products of picloram. By-products from burning plants treated with picloram were not identified in the field (USDA, 2000). Major products from burning treated vegetation include phosphorus pentoxide, acetonitrile, carbon dioxide, and water. Phosphorous pentoxide forms phosphoric acid in the presence of water. Since picloram itself has a half-life of around 18-months, the application area and amounts are small considering the scale of the landscape, and more than 95% of picloram residue is destroyed during burning, the likelihood of synergistic effects from these compounds is small. These compounds are not known to be a human health hazard at levels found in a vegetation fire (USDA, 1997).

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Motorized Equipment or Mechanical Transport in Wilderness)

Direct and Indirect Effects: Potential risks for workers and the visitors to the area would be less than Alternative C because only about 50-acres would be treated with herbicides. The risk to human health is lower with Alternative D compared to Alternative C and each would be below a level considered safe by the EPA for the herbicides proposed for use. Where herbicides are used, treatment would be done with backpack sprayers. Backpack applications have more potential for worker exposure to herbicides (see Human Health, Affected Environment section). The length time for applications needed to treat the areas would be about 40-60 worker-days. Backpack sprayers can treat about one acre per day on rugged, steep, and remote terrain. Treatment would require applications of about 40-60 worker-days in the spring. The duration of applications would be short, and more workers would decrease the exposure per worker to an even shorter period. The chance of the public encountering a spray operation would be slightly greater than Alternatives A or B. The application period would be about the same as Alternative C because the treatment acreage is concentrated on the high priority areas like the Lakeshore Trail and private land.

Handling and mixing of herbicides, and more work in close proximity to the spray nozzle would increase exposure and subsequent health risk to workers. The more time spent applying herbicides increases the risk of a spill, accident, or mishap. Risk of herbicide spills or accidents would be reduced under Alternative D as compared to Alternative C because fewer acres would be treated. The public may be secondarily exposed to a spill or release if it reaches surface or groundwater. This potential effect would be minimized by the mitigation to mix backpack sprayers outside riparian areas. The indirect effects in the form of public exposure would correspond with the proximity of the spill to the public, primarily along the Lakeshore Trail.

Alternative D includes manual, mechanical, and cultural treatments. The effects would be similar to those disclosed in Alternatives B and C.

Cumulative Effects: The cumulative effects boundary includes the project area for the next eleven years (10-years of implementation plus an extra year to account for the half-life of picloram). Because this alternative includes manual, mechanical, cultural, and chemical treatment on private lands where landowners agree, it is unlikely that private landowners would complete individual land treatments. Although this alternative would treat fewer acres, the priority for treatment would include the adjacent private lands, hence just as much treatment on private lands would occur under this alternative as Alternative C.

3.3.3 Recreation: Affected Environment

Recreation Facilities

The project area is a lakeside and mountainous environment, partly within the Lake Chelan-Sawtooth Wilderness Area. The area is used moderately by recreationists. Developed recreation sites, including boat docks and smaller improved campsites, are at Moore Point, Cascade Creek, and Prince Creek on the north side of the lake. On the south side of the lake, similar facilities are located at Lucerne, Refrigerator Harbor, and Domke Falls. The boat landing at Lucerne is a destination for lake travelers; it serves as access to Holden Village and a number of private homes in the Lucerne area. Nearby, though outside the project area, are other recreation facilities managed by the Park Service as part of the North Cascades National Park Complex. The Lakeshore Trail and other trails provide access for visitors into the Lake Chelan-Sawtooth Wilderness Area in Prince and Fish Creeks.

Recreation Visitor Use

Use includes persons who recreate in, and adjacent to, the area infested with crupina and other lake visitors. Recreation use of the lake includes private pleasure boat traffic and those who travel the lake on the commercial boat service operated by Lake Chelan Boat Company. Lake travelers can view the project area and occasionally recreate there.

Annually about 36,000-visitors take the scheduled boat service, departing either Chelan (about 2/3 of visitors) or Fields Point (about 1/3 of visitors), for up-lake destinations of Lucerne (about ¼ of visitors) or Stehekin (about ¾ of visitors). About 675-people per year begin or end trips at locations other than Lucerne or Stehekin. Those locations include Forest Service docks at Moore Point and Prince Creek, private docks and residences, and other locations. The majority of visitors use the commercial boat service in late spring, summer, and early fall. These visitor figures are generalized, as use fluctuates yearly due to weather, economic factors, and the forest fire and smoke situation in the surrounding area (personal communication Lake Chelan Boat Company, 2003).

The main trail in the area is the Lakeshore Trail, beginning at Prince Creek and traversing the north shore of the lake in a northwesterly direction. It crosses National Forest System wilderness and non-wilderness, and private land on the way to Stehekin. This trail receives most use in April, May, and June when lower temperatures allow for comfortable travel and other trails and destinations are not yet snow free. The Lakeshore Trail averages three parties per day on weekends and two parties per day on weekdays. Party size averages three persons that spend about 3-days on a trip, the average hiking time of the trail. Annually this amounts to about 618-people for 1,854 visitor-days. This figure compares well with the number of visitors reported by the commercial boat service (personal communication, Ranger District field staff).

The high-use season on the Lakeshore Trail overlaps the time for implementing proposed crupina treatments (mid-March through mid-June). After July 1, the Lakeshore Trail receives little use due to high temperature and the availability of other, more desirable, recreation areas. In late spring, as the higher elevation areas of the wilderness, the nearby North Cascades National Park, adjacent Lake Chelan National Recreation Area, and other areas become snow-free in late June and early July, use of the trail declines. Visitor access patterns to the wilderness then changes and most people use the Twisp River and trailheads on the South Navarre road due to the large elevation gain required reaching popular areas from Lake Chelan. Some use of the Lakeshore Trail and the project area also occurs during fall hunting seasons, largely from a permitted outfitter-guide base camp operation near Fish Creek.

Most of the visitors who use the Lakeshore Trail are hikers. Due to the difficulty and expense of moving recreation livestock up and down the lake, few private visitors to the area use livestock. Livestock that is in the area is mostly limited to outfitter trips. Those include several per year in the spring and summer and the fall outfitter guide hunting camp mentioned.

Boating provides the main access to the upper lake. There are about 44 camping or picnic sites in the middle zone of the Lake. Observed use at those sites is 17-sites occupied on an average weekend day. The capacity of these sites is approximately 330-people, and observed use is 68-people per night overnight and 60 people per day for average weekend use (see **Table 3-12**, CPUD, 2000a). Boaters can view the project area traveling the lake, and when coming ashore at docks, or unimproved sites along the lake for day or overnight use. About 70% of boats on Lake Chelan stay down-lake of Wapato Point, considerably below the project area (CPUD, 2000b).

Table 3-12. Estimated capacity of the lake for boats, and observed use follows.

Estimated daily boat capacity by zone	180 boats in middle* zone	96 boats in upper** zone
Observed use, entire lake above Deep Harbor Creek	33 boats average for summer weekdays – peak season	42 boats for summer weekends – peak season

*middle – from about Safety Harbor up-lake to the Wenatchee Forest/Ross Lake NRA boundary;

**upper – the portion above the Forest/NRA boundary to Stehekin.

3.3.4 Recreation: Environmental Consequences

Recreation Facilities

Alternative A (No Action)

Direct and Indirect Effects: The long-term effect of no action is a continued presence of crupina and potential spread to adjacent suitable habitat. Trails would continue to be a vector for weed spread. There would be no long-term effects on project area recreation facilities beyond normal use.

Cumulative Effects: The cumulative effects boundary is the area infested with crupina and potential suitable habitat for 10-years into the future. For visitors in the weed infested area and those traveling along the Lakeshore Trail, recreation experiences are presently negative due to the lack of plant diversity and the presence of non-native weed infestations in the area. Ongoing and foreseeable future actions include recreational use of trails, campsites, and boat landings, trail maintenance, recreational livestock grazing, fire suppression, and weed treatment on private land. Fire suppression activity would increase the likelihood of crupina spread by the movement of personnel through infested areas, and ground-disturbing actions like fireline construction. Weed treatment on private land could help prevent spread of weeds to National Forest System land. Taking no action under this alternative would not contribute to adverse effects on native vegetation and visitor experiences at recreation facilities however it would do nothing to alleviate the effects of past actions. The cumulative effects of these activities, and this alternative, would be the continued spread of crupina and continued diminished visitor experiences when using recreation facilities.

Alternative B (Only Hand-pulling Used)

Direct and Indirect Effects: Annual effects to developed recreation facilities would be short-term during periods of treatment, mid-March through mid-June. Crews and equipment would occupy some facilities such as docks during project implementation. For short periods those facilities would not be available to the public. About 1,920-person days/year of work crew time would be spent in the area. There would be no long-term effects on recreation facilities beyond normal use. Workers hand-pulling crupina would be in the area, using and visible from trails, though the trails would remain open to the public. With a priority to treat trailside crupina patches over successive years, a reduction in the infestation would be expected to make the spread of crupina via trails less likely.

Cumulative Effects: The cumulative effects boundary is the area infested with crupina and potential crupina habitat for 10-years into the future. For visitors in the weed infested area and those traveling along the Lakeshore Trail, recreation experiences are presently negative due to the lack of plant diversity and the presence of non-native weed infestations in the area. Ongoing and foreseeable

future actions include recreational use of trails, campsites, and boat landings, trail maintenance, recreational livestock grazing, fire suppression, and weed treatment on private land. Fire suppression activity would increase the likelihood of crupina spread by the movement of personnel through infested areas, and ground-disturbing actions like fireline construction. Treatment on private land could help prevent spread of crupina to National Forest System land. Past actions helped create conditions that favored the invasion of noxious weeds and impacted native vegetation and wilderness integrity. With this alternative, hand-pulling crupina would decrease spread in the short-term, especially along trail corridors. This would decrease the likelihood that recreationists and stock would spread crupina outside the current infestation area. In treated areas, this alternative would help restore native vegetation and therefore enhance the experience of visitors using recreation facilities. The cumulative effects of hand-pulling treatments and ongoing use would be a slight disruption in public use of some recreation facilities annually from mid-March through mid-June. On potential crupina habitat created by the Rex Creek fire and other areas not easily hand-pulled, crupina would spread and visitors to recreation facilities would continue to have diminished recreation experiences.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct and Indirect Effects: Direct effects to developed recreation facilities would be short-term in nature, annually. Crews and equipment may need to use facilities such as boat docks for project implementation. During those times some facilities would not be available to the public. Up to about 1,920-person days/year for hand-pulling and radiant heat disk treatments and 320-person days/year for herbicide treatments would be spent in the area. This alternative would increase overall treatment areas beyond only hand-pull areas in Alternative B. By treating more acreage and using various methods that includes herbicides and the use of pumps and helicopters in wilderness, this alternative would be more effective in limiting the spread of crupina. There would be no long-term effects on recreation facilities beyond those normally associated with regular use. Over the lifespan of this project, treatment activity along the Lakeshore Trail should decrease after the first few years, as crews complete treatment in that high priority area and move to other areas. Trails would be less of a vector in future crupina spread.

Cumulative Effects: The cumulative effects boundary is the area infested with crupina and potential habitat for 10-years into the future. For visitors in the weed infested area and those traveling along the Lakeshore Trail, recreation experiences are presently negative due to the lack of plant diversity and the presence of non-native weed infestations in the area. Ongoing and foreseeable future actions include recreational use of trails, campsites, and boat landings, trail maintenance, recreational livestock grazing, fire suppression, and weed treatment on private land. Fire suppression activity would increase the likelihood

of crupina spread by the movement of personnel through infested areas, and ground-disturbing actions like fireline construction. Weed treatment on private land could help prevent spread of weeds to National Forest System land. Past actions helped create conditions that favored the invasion of noxious weeds and impacted native vegetation and recreation visitor experiences. With this alternative, treating crupina with various methods would decrease spread, especially along trail corridors. This would decrease the likelihood that recreationists and stock would spread crupina outside the current infestation area. In treated areas, this alternative would help restore native vegetation and therefore enhance the experience of visitors using recreation facilities. The cumulative effects of crupina treatments and ongoing use would be limiting the spread of crupina allowing restoration of native vegetation along with a slight disruption in public use of some recreation facilities annually from mid-March through mid-June.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Motorized Use or Mechanized Transport in Wilderness)

Direct and Indirect Effects: Once again, there would be no long-term effects on recreation facilities beyond those normally associated with regular use. Compared with Alternative C, fewer workers and equipment would need to use the recreation facilities from mid-March through mid-June. Workers implementing treatment operations would be in the area annually up to about 1,920-person days/year for hand-pulling and radiant heat disk treatments and 160-person days/year of crew time for herbicide treatments. Without logistical support (no pumps or helicopters in wilderness), fewer acres would be treated compared with Alternative C. Only wilderness areas close to the lakeshore, easily reached by ground crews, and accessible to water would be treated. There would be a short-term reduction of crupina. Over time, however, crupina would become re-established on previously treated acres, and spread from untreated areas into presently un-infested areas. Since fewer acres would be treated, trails may still be a vector for continued crupina spread where they are not treated by herbicides due to operational constraints. This alternative would be more effective in treating and controlling crupina than Alternative B, but slightly less effective than Alternative C in helping to restore native vegetation and therefore visitor experiences at recreation facilities.

Cumulative Effects: The cumulative effects boundary is the area infested with crupina and potential crupina habitat for 10-years into the future. Past actions helped create conditions that favored the invasion of noxious weeds and impacted native vegetation and wilderness integrity. For visitors in the weed infested area and those traveling along the Lakeshore Trail, recreation experiences are presently negative due to the lack of plant diversity and the presence of non-native weed infestations in the area. Ongoing and foreseeable future actions include recreational use of trails, campsites, and boat landings, trail maintenance, recreational livestock grazing, fire suppression, and weed

treatment on private land. Fire suppression activity would increase the likelihood of crupina spread by the movement of personnel through infested areas, and ground-disturbing actions like fireline construction. Weed treatment on private land could help prevent spread of weeds to National Forest System land. With this alternative, integrated crupina treatment methods would decrease spread in the short-term, especially along trail corridors. This would decrease the likelihood that recreationists and stock would spread crupina outside the current infestation area. In the herbicide and radiant heat disk treatment areas, effects would be similar to those described in Alternative C. In the crupina areas not reached with herbicides from existing water sources, hand-pulling effects would be similar to Alternative B. On potential crupina habitat created by the Rex Creek fire and not hand-pulled, treated with herbicides, or treated with radiant heat disks, crupina would spread.

Recreation Visitor Use

Alternative A (No Action)

Direct and Indirect Effects: With no action to treat crupina, visitor use would continue. Visitors may notice the presence of weeds, and would not experience native plant communities that are displaced by the weed. Crupina would continue to spread beyond the existing infested area. There would be no interruption of recreational use from work crews and equipment due to treatment operations.

Cumulative Effects: The cumulative effects boundary is the area infested with crupina and potential crupina habitat for 10-years into the future. Other ongoing or foreseeable future activities that may affect recreation use are possible treatment of private land with herbicides, trail use and maintenance activity, and potential wildfire and fire suppression activities. These could all influence recreational use in the area, especially future fires, when it would be likely that the trail would be closed for safety.

Alternative B (Only Hand-pulling Used)

Direct and Indirect Effects: Annually, there would be crews hand-pulling crupina. Areas manually treated would get at least two inspections and treatments during the 10-year project period. Some disruption of visitors would occur annually from the presence of crews hand-pulling up to 100-acres per year. This may displace some users due to facilities not being available or because they are closed for short periods for safety. Some slight decrease in overall visitor use might be expected, but in light of other factors affecting tourism and recreational uses, the change would not be noticeable.

Visitors on the Lakeshore Trail and on the lake would notice and hear project workers. As mitigation, informational signs would be posted at trailheads and

other project area access points, and other local media would be used to let the public be aware of the planned treatments.

In the short-term after treatment, visitors along the trail would experience a greater diversity of plants, which should increase visitor enjoyment of the area. Over the long-term, however, hand-pulling would not remove all crupina from the area and weed re-invasion is likely.

Cumulative Effects: The cumulative effects boundary is the area infested with crupina and potential crupina habitat for 10-years into the future. Other ongoing or foreseeable future activities that may affect recreation use are possible treatment on private land with herbicides, trail use and maintenance activity, and potential wildfire and fire suppression activities. These could all influence recreational use in the area, especially any future fires, when it would be likely that the trail would be closed for safety.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct and Indirect Effects: Visitors on the Lakeshore Trail and on the lake would see and hear project crews, boats, pumps, and aircraft, which would reduce the quality of recreational experience. This would be reduced by the following mitigation (see also Chapter 2). Informational signs would be posted at trailheads and other wilderness access points, and other local media would be used to let the public be aware of the planned treatments. Helicopters would not be used on week-ends or holidays and helicopter use would be carefully scheduled to focus daily use periods as well. To further limit noise, no use of motorized pumps would occur within 400-feet of the Lakeshore Trail on weekends and holidays.

Implementation would result in crews and equipment working in the area. Some disruption of visitors would occur annually, from the presence of workers hand-pulling and radiant heat disking up to 100-acres of crupina, and treating up to 100-acres with herbicides. Yearly, up to 1,920-person days of crew time may be involved in manual treatments and up to 32-person days of crew time may be involved in herbicide operations. Treated acres would receive up to three treatments during the 10-year project period, up to 2-years apart. Helicopters would be used for logistical support, about once per week, or up to about 8-days yearly, to support herbicide and manual treatments. Visitors would experience odors from herbicide treatments, which may reduce their recreational experience.

Project operations may displace some users due to facilities not being available, or because they are closed for safety reasons for short periods. Some slight decrease in overall use might be expected, but in light of other factors (weather, smoke, fires, economic factors) affecting tourism and recreational uses, should be unnoticeable. Some recreation users may not visit the area due to work

crews and equipment operating during the season or avoiding herbicide use areas. After treatment, visitors should experience a greater diversity of plants, which should increase visitor satisfaction and enjoyment of the area, although some crupina may still exist.

Cumulative Effects: The cumulative effects boundary is the area infested with crupina and potential crupina habitat for 10-years into the future. Other ongoing or foreseeable future activities that may affect recreation use are possible treatment on private land with herbicides, trail use and maintenance activity, and potential wildfire and fire suppression activities. These could all influence recreational use in the area, especially any future fires, when it would be likely that the trail would be closed for safety.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Motorized Use or Mechanized Transport in Wilderness)
Direct and Indirect Effects: Lake users, hikers, and other visitors would hear and see crews and mechanical equipment in the area, including boats, pumps, and aircraft. No mechanical operations would occur in wilderness, although due to the fact that slopes in the treatment area are steep with areas more than 500-meters from the lakeshore easily visible from the lake and subject to noise from boats, floatplanes, and other aircraft, visitors would likely see and hear operations that are taking place outside of wilderness. Informational signs would be posted at trailheads and other wilderness access points, and other local media would be used to let the public be aware of the planned treatments. Depending on individual sensitivities, visitors would notice the odor from herbicides, which may diminish the recreational experience.

Implementation would result in crews and equipment to working in the area. Some disruption of visitors would occur, from the presence of hand manually treating up to 100-acres of weeds, and treating up to 50-acres annually with herbicides, yearly. Hand-pulled areas would likely receive up to three treatments during the 10-year project period. Up to 1,920-person days of crew time may be involved in hand-pulling and radiant heat disk treatments and up to 160 person-days would be involved in herbicide operations. Outside wilderness, helicopters would be used for logistical support, about once per week, or up to 8 days yearly, to support treatment operations.

Treatment operations may displace some users due to facilities not being available, or because they are closed for safety reasons for periods. Some slight decrease in overall use might be expected, but in light of other factors (weather, smoke, fires, economic factors) affecting tourism and recreational uses, should be unnoticeable. Some visitors may be discouraged from using the area because of the presence of large work crews and equipment operating during the season or avoiding herbicide use areas.

After treatment visitors would notice a greater diversity of plants, which would increase visitor satisfaction and enjoyment of the area, although crupina would still exist in some areas, especially in wilderness.

Cumulative Effects: The cumulative effects boundary is the area infested with crupina and potential crupina habitat for 10-years into the future. Other ongoing or foreseeable future activities that may affect recreation use are possible treatment on private land with herbicides, trail use and maintenance activity, and potential wildfire and fire suppression activities. These could all influence recreational use in the area, especially future fires, when it would be likely that trails would be closed for safety.

3.3.5 Wilderness: Affected Environment

Congress designated the 145,667-acre Lake Chelan-Sawtooth Wilderness Area with the Washington State Wilderness Act of 1984. Portions of the 1964 Wilderness Act are excerpted in **Appendix F**. Healthy perennial plant communities exist across the majority of the Lake Chelan-Sawtooth Wilderness Area, however crupina has gained a foothold along the north shore of Lake Chelan. Crupina threatens the wilderness resource because it is an exotic plant that displaces native species and alters plant community structure and function. For a description of how visitors use the project area and the timing of use, see Recreation: Affected Environment, section 3.3.3.

Wilderness Recreation Opportunity Class (WROS)

Wilderness management establishes standards that may preclude or limit actions. Individual wilderness areas, or parts thereof, vary in the degree of "wildness" (pristine and primitive character), degree of isolation from sounds and influences of people, and the amount of recreation visitor use. The Wenatchee National Forest LRMP divides the Lake Chelan-Sawtooth Wilderness Area into four WROS classes. These classes categorize recreational opportunities in wilderness, and provide a way of describing the relative primitive character of a particular area. Classes are based on the relative influence of factors such as the amount of visitor use, past and present evidence of human use, and disturbance factors such as the degree or amount of influence of the sight and sounds of adjacent human activity. See **Appendix G** for descriptions of each WROS class. The current crupina infestation area is in the transition and semi-

primitive zones. Most of the potential crupina habitat is in the semi-primitive zone. WROS classes, with the estimated amount of infested and potentially infested acres, are displayed below in **Table 3-13**.

Table 3-13. Acres by Wilderness Recreation Opportunity Spectrum Class, Lake Chelan-Sawtooth Wilderness (Chelan basin portion only).

WROS Class	Pristine	Primitive	Semi-Primitive	Transition	Total
Project acres	5,510	29,520	17,350	1,340	53,720
Existing crupina acres			About 300	About 200	About 500
Acres of habitat with potential for crupina spread			About 4,000	About 500	About 4,500

Standards in the Wenatchee National Forest LRMP for wilderness encounters per day state that there will be an 80% probability of no more than ten, generally, but up to 20-encounters in the transition zone, and 80% probability of no more than 10-encounters in the semi-primitive zone.

Present Situation: The project area includes wilderness, non-wilderness, and private land. Due to the topographic location of the project area, influences from human activity outside the wilderness are already evident in the wilderness. Sounds and noise from motorized boats, private residences, and aircraft are all noticeable. Visually, while most of the area appears in an unaltered state, wilderness users could expect to see evidence of human activity, including structures, boats, aircraft, and non-recreating individuals.

3.3.6 Wilderness: Environmental Consequences

The effects on the wilderness resource and visitors using the area can be categorized as follows;

- Wilderness landscape alteration;
- Land surface disturbance from crupina and proposed treatment methods;
- Effects on visitors including the sight of treatment operations and crews, the odor of herbicides, and disturbance to solitude.
- Effects of seeding native species in selected areas.

Alternative A (No Action)

Direct and Indirect Effects: This alternative would result in no known beneficial effects to wilderness. Taking no action would eliminate potential soil disturbance from trampling by crews involved in hand-pulling or spray operations.

Additionally, there would be no disruption to the wilderness or to wilderness visitors from crupina treatment operations. The negative effects of not treating infested areas would be the continued spread of crupina further into the

wilderness resulting in expansion of the area where native plant communities are reduced or eliminated. Further spread would also eventually affect wilderness visitor experiences negatively with reduced diversity of natural vegetation. There would be no seeding or planting activities to compete with crupina or other weeds.

Cumulative Effects: The cumulative effects boundary is the Lake Chelan-Sawtooth Wilderness Area within the project area 10-years into the future. Ongoing and foreseeable future actions include recreational use of trails, campsites, and boat landings, trail maintenance, recreational livestock grazing, fire suppression, and weed treatment on private land. Fire suppression activity would increase the likelihood of crupina spread by the movement of personnel through infested areas, and ground-disturbing actions like fireline construction. Weed treatment on private land could help prevent spread of weeds to wilderness. Taking no action under this alternative would not contribute to adverse effects on native vegetation and wilderness integrity, however it would do nothing to alleviate the effects of past actions. The cumulative effects of these activities, and this alternative, would be the continued spread of crupina.

Alternative B (Only Hand-pulling Used)

Direct and Indirect Effects: Effects of implementation include a reduced presence of crupina and a corresponding increase in the presence of native vegetation. Since only manual treatment would occur in this alternative it is doubtful that effects would persist indefinitely. Over the course of the 10-year treatment period, hand-pulling crews would make three trips over areas selected for treatment. Over time, crupina could become re-established on previously treated acres, and possibly continue spread into presently un-infested areas.

Disturbance to visitors would occur from workers doing manual treatment over a 60-day period (1,920-worker-days). Most treatment would occur in the wilderness transition zone and Forest Plan Standards and Guidelines allow for an 80% chance of seeing 10-20 persons or parties, or less, per day. The sight of operation personnel implementing crupina treatments would fit this category and public encounters with workers would be within this standard.

The hand-pulling crews would work in groups of up to 21-persons in size. This crew size is within the requirements of the Forest Plan, since the Forest has the ability to administratively exceed party size. Wilderness users have varied opinions regarding whether a larger party size is preferable to a greater number of small parties. While a large party could disturb some visitors, it is not appreciably different than several smaller parties working in close proximity. While no use of mechanized transport (helicopters) or other motorized use would occur in wilderness, it is possible that the sound of mechanized or motorized uses would be heard by wilderness visitors even when the sound originates

outside the wilderness, especially since the Lakeshore Trail passes close to private lands and non-wilderness lands.

Informational signs would be posted at trailheads and other wilderness access points, and other local media would be used to let the public be aware of the planned treatments. Wilderness visitors would notice some decrease in crupina, although some plants would remain and the threat of spread would continue.

Some cultural treatments (seeding) of selected areas where native vegetation is lacking would occur. Areas would be seeded or planted with native species based on presence of weeds and the amount of native vegetation present (see page 2-5, and **Table 2-1** on page 2-6). For more discussion of these effects, see the section on vegetation.

Cumulative Effects: The cumulative effects boundary is the Lake Chelan-Sawtooth Wilderness Area within the project area 10-years into the future. Ongoing and foreseeable future actions include recreational use of trails, campsites, and boat landings, trail maintenance, recreational livestock grazing, fire suppression, and weed treatment on private land. Fire suppression activity would increase the likelihood of crupina spread by the movement of personnel through infested areas, and ground-disturbing actions like fireline construction. Weed treatment on private land could help prevent spread of weeds to wilderness land. Past actions helped create conditions that favored the invasion of noxious weeds and impacted native vegetation and wilderness integrity. With this alternative, hand-pulling crupina would decrease spread in the short term, especially along trail corridors. This would decrease the likelihood that recreationists and stock would spread crupina outside the current infestation area. In treated areas, this alternative would help restore native vegetation and therefore wilderness integrity. On potential habitat created by the Rex Creek fire and other weed areas not easily hand-pulled, crupina would spread and wilderness integrity would not be restored.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct and Indirect Effects: Hand-pulling, radiant heat disk, and herbicide treatments are proposed in wilderness. This alternative would include the use of motorized equipment (pumps) and mechanized transport (helicopters) in wilderness. Helicopters would be used for logistical support one day per week, for a total of about 8 days per treatment season. Pumps would be used to supply water to herbicide application crews. Helicopters would land at existing helispots or openings in the wilderness with crews, tools, and materials. No new landings would be created. Where helicopters cannot land, a helicopter long-line would be used to place materials and tools on the ground.

Effects would be reduced spread and presence of crupina. This alternative provides the most effective means of recovering natural vegetation, since the combination of manual, mechanical, cultural (seeding), and herbicide treatments cover the most area and provide a more complete treatment than Alternatives B or D.

Following treatments, visitors in the wilderness would notice a greater quantity and diversity of native species, especially along the Lakeshore Trail. Ecosystem function in the wilderness would be disturbed by control measures, in the short term, by affecting some natural plant processes and succession.

This alternative would have the greatest disturbance to visitors, with a 60-day annual treatment period, with up to 2,240-worker-days. The crews would work in groups of up to 21-persons in size. This crew size is within the requirements of the Forest Plan, since the Forest has the ability to administratively exceed party size. Wilderness users have varied opinions regarding whether a large party is preferable to a greater number of small parties. While a large party could disturb some visitors, it is not appreciably different than several smaller parties working in close proximity. Much of the work would occur in the wilderness transition zone, and Forest Plan Standards and Guidelines allow an 80% chance of seeing 10-20 persons or parties, or less, per day. The sight of operation personnel would fit this category. Encounters with crupina treatment workers along with other parties are likely to be within this standard, although the standard does allow for a 20% chance of higher encounters. The sights and sounds of helicopters and pumps would diminish the wilderness experience for some people over a span of about 8-weeks between mid-March and mid-June. This is somewhat moderated by the "present situation" (see above, page 3-109). Also, as stated in section 3.1.9 (Wildlife and Wildlife Habitats: Affected Environment), slopes in the treatment area are steep with areas more than 500-meters from the lakeshore easily visible from the lake and subject to noise from boats, floatplanes, and other aircraft.

Informational signs would be posted at trailheads and other wilderness access points, and other local media would be used to let the public be aware of the planned treatments. Other mitigation would prevent the use of helicopters on week-ends and holidays. Helicopter use would also be carefully scheduled to focus daily use periods as well. To further limit noise related to the project treatments, no use of motorized pumps would occur within 400-feet of the Lakeshore Trail on weekends and holidays.

Some seeding of selected areas where native vegetation is lacking would occur in crupina treatment areas. Native species would be used and the likelihood of seeding would depend on the presence of weeds (other than crupina) and amount of native vegetation present (see page 2-5, and **Table 2-1**). For more discussion of these effects, see the vegetation effects section.

Depending on specific local environmental conditions and individual sensitivities, visitors to the area would notice the odor of herbicides for several hours or days after treatment. In order to monitor spray treatments, colored dyes are used in the herbicide formulations. After application, dyes may be visible on treated vegetation for varying periods depending on weather conditions. Change in color (browning) of crupina would also be noticeable to visitors as the herbicide and radiant heat disk treatments take effect.

Cumulative Effects: The cumulative effects boundary is the Lake Chelan-Sawtooth Wilderness Area within the project area 10 years into the future. Past actions helped create conditions that favored the invasion of noxious weeds and impacted native vegetation and wilderness integrity. Ongoing and foreseeable future actions include recreational use of trails, campsites, and boat landings, trail maintenance, recreational livestock grazing, fire suppression, and weed treatment on private land. Fire suppression activity would increase the likelihood of crupina spread by the movement of personnel through infested areas, and ground-disturbing actions like fireline construction. Weed treatment on private land could help prevent spread of weeds to wilderness. With this alternative, integrated crupina treatment methods would decrease spread in the short-term, especially along trail corridors. This would further decrease the likelihood that recreationists and stock would spread crupina outside the current infestation area. In treated areas, this alternative would be most effective in helping to restore native vegetation and therefore wilderness integrity. This alternative would increase overall treatment areas beyond only the hand-pull areas with Alternative B. By treating more acreage and using various methods that includes herbicides and the use of pumps and helicopters in wilderness, this alternative would be more effective in limiting the spread of crupina to potential habitat created by the Rex Creek fire. The cumulative effect would be limiting the spread of crupina allowing restoration of wilderness integrity.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Motorized Equipment or Mechanical Transport in Wilderness)

Direct and Indirect Effects: In wilderness, hand-pulling, radiant heat disk, and herbicide treatments are proposed, but no motorized equipment or mechanical transport would occur. Without the logistical support fewer wilderness acres would be treated compared with Alternative C. Only those areas close to the lakeshore easily reached by ground crews and accessible to water would be treated. There would be a short-term reduction of crupina. Over time, crupina would become re-established on previously treated acres, and spread from untreated areas into presently un-infested areas.

Visitors in the wilderness should notice an increase in quantity and diversity of native species, especially along the lakeshore trail. Other areas of the wilderness would likely continue to be affected by crupina, as the operational limitations mean that all wilderness acres would not be treated with herbicide. Ecosystem function in the wilderness would be disturbed by control measures in the short-term from the use of herbicides.

Crews would be in the area up to 60-days per year (up to 2,080-worker-days/year) treating and inspecting areas. The crews would work in groups of up to 21-persons in size. This crew size is within the requirements of the Forest Plan, since the Forest has the ability to administratively exceed party size. Wilderness users have varied opinions regarding whether a large party is preferable to a greater number of small parties. While a large party could disturb some visitors, it is not appreciably different than several smaller parties working in close proximity. While not used in wilderness, motorized equipment or mechanical transport would still be noticeable by some wilderness users due to the "present situation" (page 3-109) and the fact that slopes in the treatment area are steep with areas more than 500-meters from the lakeshore easily visible from the lake and subject to noise from boats, floatplanes, and other aircraft.

Informational signs would be posted at trailheads and other wilderness access points, and other local media would be used to let the public be aware of the planned treatments. Depending on specific local environmental conditions and individual sensitivities, visitors to the area would notice the odor of herbicides for several hours or days after treatment. In order to monitor spray treatments, colored dyes are used in the herbicide formulations. After application, dyes may be visible on treated vegetation for varying periods depending on weather conditions. Change in color (browning) of crupina would also be noticeable to visitors as the herbicide and radiant heat disk treatments take effect.

Some seeding of selected areas where native vegetation is lacking would occur. Areas would be seeded or planted with native species based on presence of weeds and amount of native vegetation present (see page 2-5, and **Table 2-1**). For more discussion of these effects, see the vegetation effects section.

Cumulative Effects: The cumulative effects boundary is the Lake Chelan-Sawtooth Wilderness within the project area 10-years into the future. Past actions helped create conditions that favored the invasion of noxious weeds and impacted native vegetation and wilderness integrity. Ongoing and foreseeable future actions include recreational use of trails, campsites, and boat landings, trail maintenance, recreational livestock grazing, fire suppression, and weed treatment on private land. Fire suppression activity would increase the likelihood of crupina spread by the movement of personnel through infested areas, and ground-disturbing actions like fireline construction. Weed treatment on private land could help prevent spread of weeds to wilderness. With this alternative, integrated crupina treatment methods would decrease spread in the short-term,

especially along trail corridors. This would further decrease the likelihood that recreationists and stock would spread crupina outside the current infestation area. In the herbicide and radiant heat disk treatment areas, effects would be similar to those described in Alternative C. In the crupina areas not reached with herbicides from existing water sources, hand-pulling effects would be similar to Alternative B. This alternative would be more effective than Alternative B in helping to restore native vegetation and therefore wilderness integrity by treating more acreage and using various methods. The effects of these activities, and this alternative, would be no substantial change in the overall extent of the crupina infestation. On potential crupina habitat created by the Rex Creek that is not hand-pulled, treated with herbicides, or treated with heated disks, crupina would spread.

Short-Term and Long -Term Changes in WROS

There would be no short- or long-term change in WROS classification, based on any of the proposed actions.

3.3.7 Unloaded Character

All National Forest System lands in the project area are either designated wilderness or have unloaded character. The National Forest System land outside wilderness is not in an Inventoried Roadless Area, however those areas do not have roads. None of the project effects, as implemented in any of the alternatives, would alter any unloaded characteristics of non-wilderness land, since there would be no removal of timber and no construction of roads, landings, or other facilities.

3.3.8 Scenery: Affected Environment

The scenic quality objective for the area is preservation in wilderness and retention in other areas. The project area has high scenic value and presently exhibits an almost total naturally-appearing setting, except directly along the Lakeshore Trail where crupina has replaced native vegetation. The views from Lake Chelan to the surrounding slopes and the views of the lake from the surrounding terrain have few intrusions from man-made elements. Those that do appear are the result of facilities for recreation users, or scattered developments on private lands.

3.3.9 Scenery: Environmental Consequences

All proposed actions under any of the alternatives would meet Forest Plan scenic quality objectives.

Alternative A (No Action)

Direct, Indirect, and Cumulative Effects: Implementation of this alternative would allow crupina to continue spreading. This would impact the immediate foreground as people view a landscape that is altered by crupina. Foreseeable wildfire would further alter scenery in the short-term. There are no other cumulative effects to scenery from this alternative.

Alternative B (Only Hand-pulling Used)

Direct, Indirect, and Cumulative Effects: Implementation of this alternative would allow crupina to continue to spread outside of high priority control areas. This would impact the immediate foreground as viewed close up, as people would view a landscape that is altered. Along the Lakeshore Trail visitors would see some improvement due to focus of treatment and control efforts there. Foreseeable wildfire would further alter scenery in the short-term. There are no other cumulative effects to scenery from this alternative.

Alternative C (Proposed Action Using Hand-pulling, Herbicides, and Radiant Heat Disks)

Direct, Indirect, and Cumulative Effects: In order to monitor spray treatments, colored dyes are used in the herbicide formulations. After application, dyes may be visible on treated vegetation for varying periods depending on weather conditions. A change in color (browning) of crupina would also be noticeable in the foreground to visitors as herbicide and radiant heat disk treatments take effect.

In areas where herbicides are used to eradicate crupina with follow-up native seeding, this alternative would provide some opportunity to keep, or return scenery to the most naturally appearing. Where herbicides are not used or seeding is not accomplished the potential for re-infestation of crupina or other weeds exists and the scenic integrity would still appear impacted to a visitor in the immediate foreground.

As seen from the immediate foreground, implementation of this alternative would provide the best opportunity to keep or return the scenery and its qualities to the most naturally appearing state. This is due to the trend toward crupina eradication and follow-up native seeding and planting afterward. Foreseeable wildfire would further alter scenery in the short-term. There are no other cumulative effects to scenery from this alternative.

Alternative D (Hand-pulling, Herbicides, and Radiant Heat Disks Used—No Motorized Use or Mechanized Transport in Wilderness)

Direct, Indirect, and Cumulative Effects: In order to monitor spray treatments, colored dyes are used in the herbicide formulations. After application, dyes may be visible on treated vegetation for varying periods depending on weather conditions. A change in color (browning) of crupina would also be noticeable in the foreground to visitors as the herbicide and radiant heat disk treatments take effect.

In the limited areas where herbicides are used to eradicate crupina with follow-up native seeding, this alternative would provide some opportunity to keep, or return, scenery to the most naturally appearing. Where herbicides are not used or seeding is not accomplished the potential for re-infestation of crupina or other weeds exists and the scenic integrity would still appear impacted to a visitor in the immediate foreground. Foreseeable wildfire would further alter scenery in the short-term. There are no other cumulative effects to scenery from this alternative.

3.3.10 Heritage Resources: Affected Environment

Across the Okanogan and Wenatchee National Forests heritage resources are based on artifact typology, density, and distribution. Heritage resources are further defined as:

- a locus of interpretable human activity that contains physical manifestations of that activity;
- generally one or more features with or without artifacts;
- one or more formal tools found in association with other cultural materials;
- diverse cultural materials in densities beyond the level of one or a few lost artifacts;
- or physical manifestations of human activity that in the professional opinion of an archaeologist are indicative of purposeful human activity at least fifty years old.

Traditional Cultural Properties are heritage resources that are important to the traditions, beliefs, practices, and lifeways of a community, an Indian tribe, a local ethnic group, or to the nation as a whole.

A sample survey based on the Wenatchee National Forest site/survey model was conducted in the current crupina infestation of about 450-acres in 1990.

Additionally, hand-pulling areas were surveyed and monitored by certified cultural resource technicians from 1995 through 2001.

Much of the area infested with crupina has steep, dry, south-facing slopes that are generally less suitable for human resource exploitation. There is a low probability for presence of heritage resources. The distribution of documented archaeological sites suggests that American Indian use of the area was limited to mostly transient seasonal camps and/or small villages on the alluvial fans of the major lake tributaries. Some of these camps and villages were inundated in 1928 when the Chelan Dam was completed and the lake level raised by 21-feet. Mountain goats, mule deer, seeds, bulbs, and berries found in upland areas of the lake basin were exploited as well but these types of activities have left little in the way of material evidence. The lake itself was an important travelway between the east and west sides of the Cascades. Early explorers reported Indian use of canoes to reach Stehekin, from which trails went up the Stehekin River and Agnes Creek to their west-side counterparts and the Cascade and Suiattle Rivers. To date the only documented heritage resource within an infested area is the Lakeshore Trail, originally constructed between 1925 and 1931 to provide access to fire lookouts and guard stations. Culturally important species that may have been displaced by crupina include balsamroot, spring beauty, dogbane, and various lomatiums.

Historical development of up-lake areas began with the establishment of the town of Chelan in 1896. The first settlers, Dumke and Sanders, came to Chelan via a perilous crossing of the Chelan Sawtooth Range from the Methow Valley. Prince Creek, at the southern end of the project area, is named for a horse that was killed while attempting to descend that drainage to the lake. Once the town of Chelan was established, supply for up-lake exploration expeditions became a comparatively feasible endeavor and mineral prospecting began in earnest. Historical mine explorations are documented throughout the basin and near the project area.

As miners poured into the area, entrepreneurs followed to provide accommodations. Hotels for miners were established at Moore Point and Meadow Creek. The Meadow Creek Lodge still stands on private land acquired through mill site patents. Moore's Inn was established at Moore Point in 1889. The hotel was relocated and rebuilt in the late 1920s when the lake level was raised for the Chelan Dam. Although the Inn itself was destroyed by fire in 1957 and all associated outbuildings and a swimming pool were removed when the Forest Service acquired the site in 1972, many historical features such as a water diversion and irrigation system, an orchard, rock terraces, foundations, and hay field remain. These features will not be affected by proposed project operations.

The resort era in the upper reaches of Lake Chelan was accompanied by some limited effort at homesteading. All private land within the project area dates from the turn of the century and consists of homestead claims or mine/mill patents. S. J. Gray took up a 160-acre homestead at Prince Creek that included a mile of lakefront where he intended to cultivate fruit and vegetables. No evidence of that effort remains. Other ambitious settlers took up homesteads on the top of Round Mountain and on Hunts Bluff, but no evidence has been located within areas infested with crupina. These areas also burned in the 2001, Rex Creek fire. The Schwecke homestead remains in the Hunts Bluff area. The area around the homestead burned, as did one outbuilding. Barn and corral facilities at the "Girl Scout" camp also burned in 2001.

Historical Forest Service developments in the project area include the trail system and a phone line. The line was removed when the lookout system was dismantled and only wire, footings, and insulators remain. The Prince Creek alluvial bar was the site of a Forest Service guard station that was washed away by the flood of 1948. The bar was comparatively well developed by the Forest Service in the late 1920s due to its popularity as a summer Boy Scout Camp. The alluvial bar burned heavily during the Rex Creek fire. Other than portions of the trail system (Lakeshore, Fish Creek, Prince Creek, and Horton Butte trails), most Forest Service developments retain little integrity. Abandoned trails include the Blue Jay Way and Meadow Creek trails, both of which accessed mining claims or activities at some time in the past.

3.3.11 Heritage Resources: Environmental Consequences

In accordance with Section 106 of the National Historic Preservation Act (36 CFR 800), a finding of “no historic properties affected” will be rendered when eligible sites are found and avoided by project-related actions. The heritage resource mitigation listed in Chapter 2 of this EIS uses a buffer zone to avoid sites that could be affected by the action alternatives.

If any undocumented National Register eligible or potentially eligible heritage resources are discovered that cannot be protected through project design and avoidance, the Forest Heritage Program Manager, tribal governments, and the State Historic Preservation Officer will be consulted. The site(s) will be documented and evaluated and all required mitigation work, including tribal consultation would be completed prior to project completion.

Alternative A (No Action)

Direct and Indirect Effects: This alternative would not directly affect heritage resources. However, expansion of the crupina infestation, which usually involves expansion of associated weeds such as cheatgrass, may indirectly affect heritage resources susceptible to wildfire (e.g. sites with wooden features, cabins) if fuels is sufficient. To date all documented heritage resources and all high probability areas where heritage resource sites may occur have burned repeatedly, most recently during the Rex Creek fire. Historical sites and buildings on private land may be at some increased risk from fire earlier in the season if the infestation expands. However, most of these buildings have had fuel reduction activities conducted around them and are at lower risk of damage in the short-term.

Action Alternatives (B, C, or D)

Direct and Indirect Effects: Any action to control crupina that involves ground disturbance would have some potential to affect heritage resources. Artifact displacement may occur with foot traffic and hand-pulling but these effects are unlikely to be adverse based on the following:

- previous impacts to heritage resources from fire, fire suppression activity, floods, inundation from the raising of Lake Chelan, and prior animal and human foot traffic;
- previous inventory of high site probability areas and avoidance of documented sites;
- low probability for heritage resources in infested areas;
- ground-disturbing activities associated with the project include foot traffic and hand-pulling – relatively low impact to soils and minimal displacement of surface and/or subsurface artifacts;
- avoidance of sensitive areas during base camp operations;

- absence of fire-sensitive materials on documented heritage resource sites in surveyed areas of the project area; and
- absence of fire sensitive materials that would be affected by radiant heat disk.

There would be little difference between action alternatives. This is due to the similar nature of potential base camp area impacts and the low probability for heritage resource occurrence in the project area, particularly treatment acreage beyond the trail corridor (the acres that vary most between alternatives). Each of the action alternatives would eventually treat all acres infested with crupina, though under Alternatives B and D this is not likely to occur within the 10-year lifespan of the project. The differences between alternatives include:

- Alternatives B and D would take longer to control crupina, than Alternative C (probably much longer than the 10-year period, which would require additional analysis);
- There is a higher probability that Alternative C would slow or prevent the spread of crupina to potential crupina habitat;
- Alternative C would potentially result in fewer acres that need repeat treatment and therefore fewer heritage resources would be potentially affected;
- Culturally important species that may be affected by treatment include balsamroot, spring beauty, dogbane, and various lomatiums. These plants are perennials that would be less affected by herbicide treatments than they would by the crupina infestation due to resistant plant reserves below ground.

Cumulative Effects (all Alternatives): The cumulative effects boundary for heritage resources is the actual treatment areas for the 10-year lifespan of the project. Past activities (removal of lookout system and phone line, removal of Moore's Inn buildings, recreational occupation of high probability sites on alluvial fans, inundation from Chelan Dam, weed invasion, and fires) have affected prehistoric and historic resources in the project area. Base camp activities associated with hand-pulling crupina have been on-going for the past 15-years. Currently, there are no known on-going effects to known or high probability sites other than some shoreline erosion. Shoreline erosion and fuel build-up around historic buildings on private land related to crupina are the only on-going effects to heritage resources anticipated to continue in the future. No shoreline erosion is anticipated to occur from any of the action alternatives since crupina does not currently infest eroding shoreline areas. Potential future infestation of shoreline areas is addressed in the proposed mitigations for the re-licensing of the Chelan Dam. Reasonably foreseeable future actions include fire suppression that would likely mitigate adverse effects associated with crupina related fuel build-ups. With continued effective mitigation of base camp activities in the project area, no cumulative effects to heritage resources are anticipated under any of the action alternatives.

3.3.12 Other Social Effects

Consumers, Civil Rights, Minorities, Women and Native Americans

The proposed project is expected to have no adverse effects on consumers, civil rights, minorities, or women. Civil Rights would not be affected by any of the alternatives. The project includes both Forest Service contracted work and Forest Service employee accomplished work. Under Executive Order 11246, companies with Federal contracts or subcontracts are prohibited from job discrimination the basis of race, color, religion, sex or national origin. The U. S. Department of Agriculture prohibits discrimination in its employment practices based on race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital and family status.

Environmental Justice

Executive Order 12898 (59 Fed. Reg. 7629, 1994) directs Federal agencies to identify and address, as appropriate, any disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. In accordance with label instructions, pregnant women or anyone known to be sensitive to herbicides would not be required to apply herbicides but those women or sensitive individuals would be given other work in lieu of herbicide application. This project is not expected to disproportionately affect these population segments. All users of the Lake Chelan-Sawtooth Wilderness Area and adjacent lands would be equally affected regardless of income status or race.

Effects to American Indian Tribes

No effects are anticipated to the American Indian Religious Freedom Act. No impacts on American Indian social, economic or subsistence rights are anticipated. The Forest Supervisor consulted with the Yakama Indian Nation and the Confederated Tribes of the Colville Indian Reservation through a government-to-government letter sent on June 3, 2002. No concerns were raised by either of these Tribes regarding this project.

3.3.13 Economics

Alternative A

Direct/Indirect Effects:

No direct or indirect costs would be associated with this alternative.

Cumulative Effects

The Forest Service has expended a considerable amount of funding hand-pulling crupina in the analysis area over the past decade. Without any continuing treatment, the value of the previous treatments would be lost as crupina reinvades the previously treated areas.

Alternative B

Direct/Indirect Effects

Hand-pulling, heat disk, and seeding treatments would cost about \$146,000 per year.

Cumulative Effects

Treatment efforts under this alternative are likely to keep crupina from re-invading previously hand-pulled sites. The investment associated with hand-pulling in the past would be protected as long as treatment is still ongoing under this alternative.

Alternative C

Direct/Indirect Effects

Hand-pulling, heat disk, and seeding treatments would cost about \$146,000 per year. The additional herbicide spraying and seeding would cost about \$83,264 per year, including the costs of helicopters and pumps.

Cumulative Effects

This alternative would be the most likely to prevent weed re-invasion into areas already treated and into new areas. The investment associated with hand-pulling in the past would likely be protected both during implementation of this project and into the future.

Alternative D

Direct/Indirect Effects

Hand-pulling, heat disk, and seeding treatments would cost about \$146,000 per year. The additional herbicide spraying and seeding would cost about \$41,632 per year, including the costs of helicopters and pumps.

Cumulative Effects

Hand-pulling, heat disk, seeding, and limited herbicide treatments are likely to keep crupina from re-invading previously treated sites. The investment associated with hand-pulling in the past would be protected during implementation of this project and likely into the future. Less accessible areas that had not previously been treated are likely to experience crupina spread.

Section 3.4 – Disclosures

Section 102 of the National Environmental Policy Act of 1969, mandates all agencies of the Federal Government to consider and display, for all alternatives, energy requirements and conservation potential of the alternatives, natural or depletable resource requirements, irreversible and irretrievable effects, effects on urban quality, historic and cultural resources any unavoidable effects caused by the proposed action, and potential conflicts with other plans. The project area contains no urban areas, and historic and cultural resources effects are in Heritage Resources above.

3.4.1 Adverse Effects Which Cannot be Avoided

Adverse effects that cannot be avoided are discussed in detail in the preceding resource sections. These effects include disturbance of soil, vegetation, wildlife and recreational activities. Potential impacts to non-target plants from herbicides are mitigated by the use backpack sprayers applied to individual plants. Potential impacts to wildlife and recreationists are mitigated by limiting operations during weekends and Federal holidays, and only allowing the helicopter to operate one day a week.

3.4.2 Short-Term Use Versus Long-Term Productivity

The activities proposed do not involve any “use” of the lands, although some short term uses will be affected by project activities and these effects are discussed in the preceding resource sections. This project should increase long-term productivity of the land by restoring native vegetation.

3.4.3 Effects on Energy and Conservation and Irreversible or Irretrievable Effects

No irreversible or irretrievable commitments of resources would occur under any alternative except the use of fuel during use of heat disks (propane), helicopters, boats, or pumps (gasoline/diesel) in Alternatives C and D. The highest amount of fuel would occur in Alternative C, but restrictions on helicopter use to once a week, and pump use to other than weekends and holidays would limit fuel use. Alternative D would may also use a helicopter for staging and pumps, however, because use would not occur in the Lake Chelan-Sawtooth Wilderness Area, such use would be very limited if any. The table below gives an estimate of annual fuel use for the project. Assumptions used in this analysis are one boat trip per week (70 miles round trip; crews may also be delivered by public transportation on the lake), one day of helicopter operation per week (Alt. C: 8 hours; Alt. D: 4 hours) and 10 hours of pump operation per week in Alternative C with 5 hours of pump operation per week in Alternative D.

Table 3-14. Annual Energy Consumption

	Alternative A	Alternative B	Alternative C	Alternative D
Gas and oil for boat	None	186 gallon*	186 gal gas*	186 gal gas*
Gas and oil for helicopter	None	None	3840 gal gas*	1920 gal gas*
Gas and oil for pumps	None	None	33 gal gas*	17 gal gas*
Propane for heated disk	None	None	<10 gallons	<10 gallons

* negligible use of oil

No other irreversible or irretrievable effects are expected.

3.4.4 Possible Conflicts Between the Proposed Action and the Objectives of Federal, Regional, State and Local Land Use Plans, Policies and Controls

This project is consistent with the Forest Plan and Federal, State, and local requirements to control and eliminate Class A noxious weeds. The purpose of this project is to control and move toward eradication of crupina.

Chapter 4
List of Preparers
and
List of Agencies, Organizations, and Persons to
Whom Copies of the FEIS were Provided

**Chapter
4**

List of Preparers and List of Agencies, Organizations, and Persons to Whom Copies of the FEIS were Provided

Section 4.1 List of Preparers

Jim Archambeault - Recreation Planner

B.A. History, Colorado State University, 1973. Graduate credit in Outdoor Recreation, Utah State University, 1989.

Thirty years experience in recreation and wilderness management and planning on the Bureau of Land Management, Utah; and the Gila, Okanogan, and Okanogan and Wenatchee National Forests.

Philip Archibald - Fishery Biologist

B.S. in Fishery Science, University of Washington, 1990.

Twelve years experience in fish/aquatic data collection and analysis, technical assistance to watershed planning groups, environmental analysis for many projects (range, restoration, hydro re-licensing, timber sales, mine clean-up, recreation), Fishery Biological Assessments, Watershed Analyses, and Forest Plan monitoring on the Wenatchee, and Okanogan and Wenatchee National Forests.

Mel Bennett – Hydrologist

B. S. Forest Management, Washington State University, 1970. M. S. Forestry (soil and water resource management emphasis), Washington State University, 1975.

Thirty-two years experience with planning for vegetation management, mining, recreation and water resource projects; soil survey and mapping; land management planning; program management for water, soil, range and noxious weed programs on the Boise, Clearwater, Okanogan, and Okanogan and Wenatchee National Forests. Twenty-two years as owner, operator and manager of apple orchard in Chelan County.

Jan Flatten - Environmental Coordinator

B.A. Geography, California State University, Northridge, 1977. Masters studies in geography, Oregon State University, 1980.

Twenty-three years experience in timber sale planning, land management planning and implementation, environmental policy and review, appeals and litigation on the Willamette, Okanogan, and Okanogan and Wenatchee National Forests.

Mallory Lenz - Wildlife Biologist, Cultural Resource Technician

B.A. General Biology/Ecology, University of California, Berkeley, 1981.
M.S. Forest Resources/Wildlife Sciences, University of Washington, 1993.
Eighteen years experience cultural resources, botany, noxious weeds, wildlife, and other resources on the Wenatchee, and Okanogan and Wenatchee National Forests.

Don B.G. Phillips - Forester

B.S. Biological Sciences, University of California, Irvine, 1973. M.S. Forest Resources, University of Idaho, 1980.
Twenty-five years experience in timber sale preparation and other project planning on the Idaho Panhandle, Lassen, Okanogan, and Okanogan and Wenatchee National Forests.

Brigitte Ranne - Zone Botanist

B.S. Physical Geography, minor Archaeology, Oregon State University, 1992; M.A. Geography Vegetation Ecology, University of Wyoming, 1995.
Eight years experience in various plant surveys and management, biological assessments, environmental analysis, and noxious weed management on the Wenatchee, and Okanogan and Wenatchee National Forests.

Jack Rainford – Information Analyst

A.A. Forestry, Green River Community College, 1975.
Twenty-seven years experience in timber, fire, and information management on the Okanogan, Wenatchee, and Okanogan and Wenatchee National Forests.

Section 4.2 Agencies, Organizations, and Persons To Whom Copies of the FEIS were Provided

Agencies and Organizations

Advisory Council on Historic Preservation
Backcountry Horsemen of Washington, Methow Chapter
Kettle Range Conservation Group
NOAA Fisheries
Northwest Coalition for Alternatives to Pesticides NW Ecosystem Alliance
Northwest Power Planning Council
Office of Housing and Urban Development
Okanogan County Noxious Weed Board
Oregonians for Food and Shelter
U.S. Army Corps of Engineers

Agencies and Organizations (continued)

USDA, Animal and Plant Health Inspection Service
USDA, Forest Service, Environmental Coordination
USDA, Natural Resources Conservation Service
USDA, National Agricultural Library
USDA, Office of Publications
USDA, Policy and Planning, Office of Civil Rights
U.S. Department of Energy
U.S. Department of the Interior
U.S. Environmental Protection Agency
U.S. Federal Aviation Administration
U.S. Federal Highway Administration
U.S. Federal Railroad Administration
Washington State Department of Ecology
Wilderness Watch

Persons

Walter Brookshire
Michael Barnhart
Richard Carpenter
Susan Crampton
David Huey
Bruce Hurst
Darrell Lewman
Mark Miller
Marshall Miller
Cathy Morehead
Dean Morehead
Ellis Morehead
Nick Nolan
Jeff Polley
Cindy Roche
Margaret Schwecke
Edward Shirk
Rick and Cristi Swartz
Wall Properties LLC
Jim Wall
Grace Yount

Appendices

Changes between the Draft and Final Environmental Impact Statements:

Added **Appendix J** (Agency Letters and Response to Comments) and **Appendix K** (Response to Public Comments).

Appendix A

References

Chapter 1

Kimberling, D.N., B.J. Shanafelt, C.G. Parks, D.E. Knecht, and E.J. DePuit, 2003. *Potential Influences of Forest Service Land Management on Invasive Plant Species in Pacific Northwest Forests and Rangelands: A Review*. Oregon State University, Department of Forest Science, Corvallis, Oregon; USDA Forest Service, Pacific Northwest Research Station, Wenatchee Forestry Sciences Laboratory, Wenatchee, Washington; USDA Forest Service, Pacific Northwest Research Station, La Grande, Oregon; USDA, Forest Service, Pacific Northwest Region, Portland, Oregon. Draft—July, 2003. FOR INTERNAL FOREST SERVICE USE ONLY---NOT FOR DISTRIBUTION.

Prather, T.S., R.H. Callihan, and D.C. Thill, 1991. *Common crupina biology, management, and eradication*. University of Idaho, College of Agriculture, Cooperative Extension System, Agricultural Experiment Station, Current Information Series No. 880, 4 pages.

Sheley, R.L. and J.K. Petroff (eds.) 1999. Biology and Management of Noxious Weeds. Oregon State University Press, pp. 189-201.

OWNF (Okanogan and Wenatchee National Forests), 2002. *Okanogan and Wenatchee National Forests Weed Management and Prevention Strategy*. Wenatchee, Washington.

USDA, 1988. *Final Environmental Impact Statement (FEIS) for Managing Competing and Unwanted Vegetation and the associated Mediated Agreement (1989)*. Forest Service, Pacific Northwest Region, Portland, Oregon.

USDA, 1994. *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (Northwest Forest Plan)*. Forest Service, Pacific Northwest Region, Portland, Oregon.

USDA, 1996. *Interior Columbia Basin Ecosystem Management Project (ICBMP)*. Forest Service, Pacific Northwest Region, Walla Walla, Washington.

USDA, 1997. *An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume II*; PNW GTR-405. Forest Service, Pacific Northwest Region, Portland, Oregon.

USDA, 2001. *Forest Service Guide to Noxious Weed Prevention Practices*. Forest Service, Washington DC.

USDA, 2003a. Glyphosate - Revised Human Health and Ecological Risk Assessment Final Report. Syracuse Environmental Research Associates, Inc. Fayetteville, New York. Syracuse Research Corporation. Syracuse, New York. 281 pages.

USDA, 2003b. Picloram - Revised Human Health and Ecological Risk Assessment Final Report. Syracuse Environmental Research Associates, Inc. Fayetteville, New York. Syracuse Research Corporation. Syracuse, New York. 133 pages.

WNF (Wenatchee National Forest), 1990. *Wenatchee National Forest Land and Resource Management Plan*, Wenatchee, Washington.

WNF, 1999. Middle Chelan Watershed Analysis. USDA, Forest Service, Wenatchee National Forest, Chelan Ranger District, Chelan, Washington.

Chapter 2

OWNF (Okanogan and Wenatchee National Forests), 2002. *Okanogan and Wenatchee National Forests Weed Management and Prevention Strategy*. Wenatchee, Washington, June 2002

Chapter 3

Native Vegetation, Competing and Unwanted Vegetation, Sensitive Plants

Arnett, J. and J. Gamon, 1990. Report on Sensitive Plant Species Along Lake Chelan in Association with *Crupina vulgaris*. Washington Natural Heritage Program, Department of Natural Resources, Olympia, Washington.

Kimberling, D.N., B.J. Shanafelt, C.G. Parks, D.E. Knecht, and E.J. DePuit, 2003. *Potential Influences of Forest Service Land Management on Invasive Plant Species in Pacific Northwest Forests and Rangelands: A Review*. Oregon State University, Department of Forest Science, Corvallis, Oregon; USDA Forest Service, Pacific Northwest Research Station, Wenatchee Forestry Sciences Laboratory, Wenatchee, Washington; USDA Forest Service, Pacific Northwest Research Station, La Grande, Oregon; USDA, Forest Service, Pacific Northwest Region, Portland, Oregon. Draft—July, 2003. FOR INTERNAL FOREST SERVICE USE ONLY---NOT FOR DISTRIBUTION.

Miller, T.L. 1982. Biology and Control of Common Crupina. Masters Thesis. University of Idaho, Moscow, Idaho..

Prather, T.S., R.H. Callihan, and D.C. Thill, 1991. *Common crupina biology, management, and eradication.* University of Idaho, College of Agriculture, Cooperative Extension System, Agricultural Experiment Station, Current Information Series No. 880, 4 pages.

Prather, T.S., S.S. Robins, and T.W. Miller, 2003. Idaho's Noxious Weeds, University of Idaho Press. Moscow, Idaho. 76 pages.

USDA, 1988. *Final Environmental Impact Statement (FEIS) for Managing Competing and Unwanted Vegetation and the associated Mediated Agreement (1989).* Forest Service, Pacific Northwest Region, Portland, Oregon.

Wildlife and Wildlife Habitats

Dow Elcano, 1994. Answers to Questions about Tordon®. Form 227-42-025. Indianapolis, Indiana. 7 sheets.

Duncan, N., T.E. Burke, S. Dowland and P. Hohenlohe, 2003. Survey Protocol for Survey and Manage Terrestrial Mollusk Species from the Northwest Forest Plan. USDI, Fish and Wildlife Service and Bureau of Land Management/USDA, Forest Service. Portland, Oregon. 70pp.

Dvornich, K.M., K.R. McAllister, and K.B. Aubry, 1997. Amphibians and Reptiles of Washington State: Location data and predicted distributions, Volume 2 in Washington State Gap Analysis – Final Report (K.M. Cassidy, C.E. Grue, M.R. Smith and K.M. Dvornich, eds.) Washington Cooperative Fish and Wildlife Research Unit, University of Washington, Seattle, Washington. 146 pp.

Knick, S.T., and J.T. Rotenberry, 1995. Landscape characteristics of fragmented shrubsteppe habitats and breeding passerine birds. *Conservation Biology* 9:1059-1071.

Lehmkuhl, J.F., J.G. Kie, L.C. Bender, G. Servheen, and H. Nyberg, 2001. Evaluating the effects of Ecosystem Management Alternatives on Elk, Mule Deer, and White-tailed Deer in the Interior Columbia River Basin, USA. *Forest Ecology and Management.* 153:89-104.

Lehmkuhl, J.F., M.G. Raphael, R.S. Holthausen, J.R. Hickenbottom, R.H. Naney, and J.S. Shelly, 1997. Historical and Current Status of Terrestrial Species and the Effects of Proposed Alternatives. USDA, Forest Service, PNW-GTR-406.

McAllister, K.R. and W.P. Leonard, 1993. Searches for Spotted Frogs and Other Amphibians on National Forest Lands in Washington. Unpublished Report, Washington Department of Fish and Wildlife, Olympia, Washington. 228 pp.

Melgoza, G., R.S. Nowak, and R. J. Tausch, 1990. Soil water exploitation after fire: competition between *Bromus tectorum* (cheatgrass) and two native species. *Oecologia*. 83: 7-13.

Melgoza, G., and R.S. Nowak, 1991. Competition between cheatgrass and two native species after fire: Implications from observations and measurements of root distribution. *Journal of Range Management*. 44(1):27-33.

Miller, T.J., 1982. Biology and Control of Common Crupina (*Crupina vulgaris* Cass.) M.S. Thesis. University of Idaho, Moscow, Idaho.

Storm, R.M. and W.P. Leonard, eds., 1995. Reptiles of Washington and Oregon. Seattle Audubon Society. Seattle, Washington. 176 pp.

Thill, D.C., D.L. Zamora, and D.L. Kambitsch, 1986. The germination and viability of excreted common crupina (*Crupina vulgaris*) achenes. *Weed Science*. 34:237-241.

Updike, D.R., E.R. Loft, and F.A. Hall, 1990. Wildfires on Big Sagebrush-Antelope Bitterbrush Range in Northeastern California: Implications for Deer Populations. pp 41-45. In: Proceedings – Symposium on Cheatgrass Invasion, Shrub Die-off, and Other Aspects of Shrub Biology and Management.

USDA, 1997. Glyphosate Herbicide Information Profile. Pacific Northwest Region, Portland, Oregon. 14 pp.

USDA, 2000. Picloram Herbicide Information Profile. Pacific Northwest Region, Portland, Oregon. 12 pp.

USDI, 2002. Endangered, Threatened, Proposed, and Candidate Species, Critical Habitat and Species of Concern located within the East Slopes of the Washington Cascades. Fish and Wildlife Service, Wenatchee, Washington. 3 pp.

SERA (Syracuse Environmental Research Associates, Inc.), 1996. Selected Commercial Formulations of Glyphosate – Accord®, Rodeo®, and Round-up® Pro Risk Assessment Final Report. Prepared for USDA, Forest Service Task No. 2. 159pp.

SERA (Syracuse Environmental Research Associates, Inc.), 1999. Picloram (Tordon® K and Tordon® 22K) – Final Report. Prepared for USDA, Forest Service Task No 15. 222 pp.

Tu, M., C. Hurd, J.M. Randall, 2001. Weed Control Methods Handbook. The Nature Conservancy, Version: April 2001.

USDA, 2002. Interim Guidance for Completing Endangered Species Act Consultations of Effects of the Use of Herbicides for Noxious Weed Control. Pacific Northwest Regional Office Letter of Direction Summarizing Risk Assessments. R6 Risk Assessments for Picloram and Glyphosate.

Wisdom, M.J., R.S. Holthousen, B.C. Wales, C.D. Hargis, V.A. Saab, D.C. Lee, W.J. Hann, T.D. Rich, M.M. Rowland, W.J. Murphy, and M.R. Eames, 2000. Source Habitats for Terrestrial Vertebrates of Focus in the Interior Columbia Basin: Broadscale Trends and Management Implications. USDA, Forest Service, Portland, Oregon. PNW-GTR-485.

Young, J.A., R.A. Evans, R.E. Eckert Jr., and B.L. Kay, 1987. Cheatgrass. Rangelands 9(6):266-270.

Aquatic/Fishery Resources

Brown, L.G., 1984. Lake Chelan Fishery Investigations. Chelan County PUD No. 1 and Washington State Department of Game (Fish and Wildlife), Wenatchee, Washington.

CPUD (Chelan Public Utility District), 2000a. Bypass Reach (Gorge) Flow Releases Study Report. Final Report to Chelan Hydroelectric Project No. 637, Public Utility District No.1 of Chelan County, Wenatchee, Washington.

CPUD, 2000b. Lake Chelan Fisheries Investigation. Final Report to Chelan Hydroelectric Project No. 637, Public Utility District No.1 of Chelan County, Wenatchee, Washington.

CPUD, 2000c. Riparian Zone Investigation. Final Report to Chelan Hydroelectric Project No. 637, Public Utility District No.1 of Chelan County, Wenatchee, Washington.

Helvey, J.D., 1973. Watershed Behavior After Forest Fire in Washington. Pages 403-422. In: Proceedings of the Irrigation & Drainage Division Specialty Conference, Fort Collins, Colorado. March 1973 American Society of Civil Engineers.

Robinson, C.T. and G.W. Minshall, 1993. Physical and Chemical Responses of Streams in Yellowstone Following the 1988 Wildfires. Page 29, *In: Proceedings Second Biennial Scientific Conference on the Greater Yellowstone Ecosystem - The Ecological Implications of Fire in Greater Yellowstone.*

Swanson, D.N., 1991. Natural Processes. Pages 139-177 *In: W.R. Meehan, ed. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19, Bethesda, Maryland.*

USDA, 1997. Glyphosate Herbicide Information Profile. Pacific Northwest Region, Portland, Oregon. 14 pp.

USDA, 2000. Picloram Herbicide Information Profile. Pacific Northwest Region, Portland, Oregon. 12 pp.

USDI, FWS, 1998. A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale. Prepared by the U.S. Fish and Wildlife Service (adapted from NOAA Fisheries).

WNF (Wenatchee National Forest), 1992. Prince Creek Stream Survey Report. USDA, Forest Service, Wenatchee National Forest, Wenatchee, Washington.

WNF, 1998. Fish Creek Stream Survey Report. USDA, Forest Service, Wenatchee National Forest, Wenatchee, Washington.

WNF, 1999. Middle Chelan Watershed Analysis. USDA, Forest Service, Wenatchee National Forest, Chelan Ranger District, Chelan, Washington.

Soil Resources

Amaranthus, M. P. and D. A. Perry, 1988. Interaction Effects of Vegetation Types & Pacific Madrone Soil Innocula on Survival, Growth and Mycorrhiza Formation of Douglas-fir. Paper No. 2192, Forest Res. Lab., Oregon State University, Corvallis, Oregon. 7 pages.

Amaranthus, M. P. and D. A. Perry, 1994. The Functioning of Ectomycorrhizal Fungi In the Field: Linkages In Space and Time. In: Plant and Soil 159. Kluwer Academic Publishers. Printed in the Netherlands. Pages 133-140.

Bakke, David, 2001. Estrogenic Effects and Toxicity to Aquatic Organisms from Exposure to the Surfactant R-11.

Frank, R. n.d. Managing Persistent Herbicides in Soil. Agricultural Services, Ontario Ministry of Agriculture and Food. Guelph, Ontario, pp154-161.

Hance, R.J., 1982. Herbicide Persistence, Is It A Problem? Preceedings of the 5th International Congress of Pesticide Chemistry, Hyoto, Japan.

Lacey, J. R., Marlow, C.B. & Lane, J.R., 1989. Influence of Spotted Knapweed on Surface Runoff & Sediment Yield. *Weed Tech.* Vol. 3: p. 627-631.

OWNF (Okanogan and Wenatchee National Forests), 2002. *Okanogan and Wenatchee National Forests Weed Management and Prevention Strategy*. Wenatchee, Washington. June 2002.

Prather, T.S., R.H. Callihan, and D.C. Thill, 1991. *Common crupina biology, management, and eradication*. University of Idaho, College of Agriculture, Cooperative Extension System, Agricultural Experiment Station, Current Information Series No. 880, 4 pages.

Tu, C. M. 1994. Effects of Herbicides and Fumigants on Microbial Activities in Soil. *Bulletin of Environmental Contamination and Toxicology*. 53 (1): p. 12-17.

USDA, 1997. Glyphosate Herbicide Information Profile. Pacific Northwest Region, Portland, Oregon. 14 pp.

USDA, 2000. Picloram Herbicide Information Profile. Pacific Northwest Region, Portland, Oregon. 12 pp.

Water Resources

Darrach, A. G., Neville Curtis, and W. J. Sauerwein, 1978. Technical Notes: Estimating Sheet-Rill Erosion and Sediment Yield on Rural and Forest Highways (Woodland—No. 12). USDA, Soil Conservation Service, West Technical Service Center, Portland, Oregon. 41 pages.

Gladwell, J.S. and A. C. Mueller, 1967. Water Resource Atlas of the State of Wash. Vol. 2, Part B of: An Initial Study of the Water Resources of the State of Washington. State of Washington, Water Research Center, Pullman, Washington.

Patmont, C.R., G.J. Pelletier, E.G. Welch, D. Banton, and C.C. Ebbesmeyer, 1989. Lake Chelan Water Quality Assessment. Final Report of Contract 000087072 for State of WA Department of Ecology. Olympia, Washington. Page 5-42.

Teske, M.E., S.L. Bird, D.M Esterly, S.L. Ray and S.G. Perry, 2002. A User's Guide for AgDRIFT® 2.0.05: A Tiered Approach for the Assessment of Spray Drift of Pesticides. Prepared for the Spray Drift Task Force, Stewart Agricultural Research Services, Inc., Macon, Mississippi.

USDA, 1997. Glyphosate Herbicide Information Profile. Pacific Northwest Region, Portland, Oregon. 14 pp.

USDA, 2000. Picloram Herbicide Information Profile. Pacific Northwest Region, Portland, Oregon. 12 pp.

Human Health and Safety

Arbuckle, T. 1999. Exposure to Phenoxy Herbicides and the Risk of Spontaneous Abortion (abstract). Agro-medicine Program Update, 10 (6), Clemson University. Charleston, South Carolina. 2 pages.

Charles J. 1996. Chronic dietary toxicity/oncogenicity studies on 2,4-Dichlorophenoxyacetic acid in rodents. Fundamental and Applied Toxicology 33:166-172.

Citron, M., 1995. Perplexing peroxisome proliferators. Environmental Health Perspectives, Volume 103, Number 3, March.

Cox, C., 1998. Herbicide Factsheet. Picloram. Journal of Pesticide Reform 18(1) 13-20. Eugene, Oregon.

EPA (Environmental Protection Agency), 1995. Re-registration Eligibility Decision (RED) Picloram. Prevention, Pesticides and Toxic Substances. EPA 738-R95-019. Washington, D.C. 284 pages.

EPA, 1998. Health Effects Test Guidelines OPPTS 870.1200: Acute Dermal Toxicity. EPA 712-C-98-192; Washington, D.C. 8 pages.

EPA, 2002a. Health Effects Test Guidelines OPPTS 870.1100: Acute Oral Toxicity. Prevention, Pesticides and Toxic Substances, EPA 712-C-02-190, Washington, D.C. 35 pages.

EPA, 2003b. Integrated Risk Information System, glossary of terms.

Faustini. A., L. Settimi, R. Pacifici, V. Fano, P. Zuccaro, and F. Forastiere, 1996. Immunological changes among farmers exposed to phenoxy herbicides: preliminary observations (abstract). Occupational and Environmental Medicine, 53: 583-585.

Felsot, A., 2001. Assessing the safety of herbicides for vegetation management in the Missoula Valley region - A question and answer guide to human health issues. Food and Environmental Quality Laboratory, Washington State University, Richland, Washington. 45 pages.

Glover-Kerkvliet, J., 1995. Environmental assault on immunity. *Environmental Health Perspectives*, Volume 103, Number 3.

Hayes, H., R. Tarone, K. Cantor, C. Jessen, D. McCurnin, and R. Richardson, 1991. Case-control study of canine malignant lymphoma: positive association with dog owner's use of 2,4-D (abstract).

Infoventures, 1995a. Picloram: Pesticide Fact Sheet. Prepared for the USDA, Forest Service by Information Ventures, Inc.

Infoventures, 1995b. Glyphosate: Pesticide Fact Sheet. Prepared for the USDA, Forest Service by Information Ventures, Inc.

Mattsson, J. *et. al.*, 1997. Single-dose and chronic dietary neurotoxicity screening studies on 2,4 dichlorophenoxyacetic acid in rats (abstract). *Fundamentals and Applied Toxicology* 40:101-119.

OSU (Oregon State University), 1996a. Extoxnet (Extension Toxicology Network), Pesticide Information Profiles, Picloram.

OSU, 1996b. Extoxnet (Extension Toxicology Network), Pesticide Information Profiles, Glyphosate.

Ross, J., M. Dong, and R. Krieger, 2000. Conservatism in pesticide exposure assessment. *Regulatory Toxicology and Pharmacology* 31:53-58. Syracuse Research Corporation, Syracuse, New York. Syracuse Environmental Research.

Teske, M. and H. Thistle, 1999. A simulation of Release Height and Wind Speed Effects for Drift Minimization. American Society of Agricultural Engineers. Transactions of the ASAE. Vol.42(3):583-591.

USDA, 1997. Glyphosate Herbicide Information Profile. Pacific Northwest Region, Portland, Oregon. 14 pp.

USDA, 1997a. Effects of Surfactants on the toxicity of Glyphosate, with specific Reference to Rodeo®. Syracuse Environmental Research Associates, Inc. Fayetteville, New York.

USDA, 1997b. Use and Assessment of Marker Dyes used with Herbicides Syracuse Environmental Research Associates, Inc. Fayetteville, New York.

USDA, 1997c. Selected Commercial Formulations of Hexazinone - Human Health and Ecological Risk Assessment, Final Report. Syracuse Environmental Research Associates, (SERA) Inc., Fayetteville, New York, and Syracuse Research Corporation, Syracuse, New York. 161 pages.

USDA, 2000. Picloram Herbicide Information Profile. Pacific Northwest Region, Portland, Oregon. 12 pp.

USDA, 2001. Final Report: 2,4-Dichlorophenoxyacetic Acid Formulations - Human Health and Ecological Risk Assessment. Syracuse Environmental Research Associates, Inc. Fayetteville, New York. Syracuse Research Corporation, Syracuse, New York. 82 pages.

USDA, 2003a. Glyphosate - Revised Human Health and Ecological Risk Assessment Final Report. Syracuse Environmental Research Associates, Inc. Fayetteville, New York. Syracuse Research Corporation. Syracuse, New York. 281 pages.

USDA, 2003b. Picloram - Revised Human Health and Ecological Risk Assessment Final Report. Syracuse Environmental Research Associates, Inc., Fayetteville, New York. Syracuse Research Corporation. Syracuse, New York. 133 pages.

Recreation Facilities, Visitor Use, and Wilderness

CPUD, 2000a. Data from *Recreation Needs Forecast and Analysis Final Study Report, July 2000*, Chelan County PUD, Chelan Hydroelectric Project Re-licensing.

CPUD, 2000b. Data from *Final Study Report - 1998/1999 Recreational Use Assessment, February 2000*, Chelan County PUD, Chelan Hydroelectric Project Re-licensing.

Appendix B

Crupina Integrated Weed Management Project Spill/Release Control Plan

The purpose of this plan is to ensure that the Chelan Ranger District is in compliance with the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (HCS), 29CFR 1910.1200, the USDA Forest Service Health and Safety Code Handbook (FSH 6709.11), the Forest hazardous Materials, Spill/Release Emergency Action, and Hazard Communication Plan, as well as other applicable pesticide application, control, spill and disposal laws.

Paige Balling is the overall hazardous materials management program coordinator for the Okanogan and Wenatchee National Forests, acting as the representative of the Forest Supervisor. The Chelan Ranger District hazardous materials spill/release program coordinator is Randy Niman. District coordinators act as representatives for the District Ranger.

Each employee involved with the project will be familiar with the District and Forest Hazardous Materials Spill/Release Emergency Action and Hazard Communication Plan. Each employee involved with herbicide projects will also be informed of the hazardous properties of chemicals in the work place, and measures to take to protect themselves from the potential harmful effects of these chemicals. Contractors would be required to be familiar with that portion of the Plan that deals with hazardous material spill/release emergency action.

Copies of the Pesticide Information Profiles and Spill Plan are located in the project file at the Chelan Ranger District. They are available to all employees. The Job Hazard Analysis for herbicide handling and use is located in the project file as well. This plan follows Forest Service Handbook 2109.14, chapter 30.

Noxious weed herbicide treatments will be accomplished by contractors and by Forest Service employees holding a Washington State Department of Agriculture Pesticide Applicator License. Any pesticide storage on National Forest Land or transport in Forest Service vehicles will follow procedures and guidelines in FSH 2109.14 chapter 40: Storage, Transportation, and Disposal. Herbicide mixing and loading sites will be located away from streams or ponds, in areas where the soil will not allow penetration of any spilled material, and where fast and thorough cleanup is possible. Secondary containment will be used while mixing. All containers will be stored securely on vehicles. The project spill plan will include a list of contents of a Vehicle Spill Kit. Vehicle spill kits will be with the applicator at all times during project activity. Communication will be maintained with Forest Central Dispatch as provided in the Forest and Ranger District Hazardous Materials, Spill/Release Emergency Action, Hazardous Communication Plan, during herbicide application.

Pesticide Poisoning Symptoms:

Glyphosate: Skin or eye irritation possible during loading, mixing or application. Nausea and dizziness may also be present. Acute toxicity will occur if swallowed in concentrated form; death could occur with ingestion of ½ cup or less of concentrate.

Picloram: Substantial but temporary eye irritation is possible. Rash may occur with exposure to skin.

Notification List of Key Personnel or Agencies (ref. FSH 2109.14, chapt. 30)

Local physicians familiar with diagnosis and treatment of pesticide poisoning:

Lake Chelan Community Hospital	509-682-2531
Central Washington Hospital	509-662-1511
Wenatchee Valley Hospital	509-665-5850
Methow Valley Family Practice (Twisp)	509-997-0211
Deaconess Medical Center (Spokane)	509-458-7100
Poison Control Center	800-572-9176 or 800 732-6985

Okanogan and Wenatchee National Forests:

Central Dispatch	509-662-4363
Forest Hazardous Materials Coordinator, Paige Balling	509-664-2783
Chelan Ranger District Hazmat Coordinator, Randy Niman	509-662-2576

Region, Area or Station Pesticide Use Coordinator

Okanogan and Wenatchee National Forests, Mel Bennett	509-826-3164
Forest Service Pacific Northwest Region, Gary Smith	503-326-7559

Regional EPA Office

Environmental Protection Agency Region 10, Allan Welch	206-553-1980
Washington State DOE Spill Team, Mark Layman	509-454-7829 (24-hr = 509-575-2490)
Washington Department of Emergency Services 24-hr	800-562-6108

Washington State Department of Agriculture

Pesticide Management Division: Waste, Disposal & Groundwater	360-902-2050
Pesticide Management Division: Compliance	360-902-2040

Highway Patrol or Local Police Department

Chelan County Sheriff	509-667-6851 or 911
Washington State Patrol (Wenatchee)	800-663-9721 or 911
Chelan City Police	509-682-2588 or 911

Pesticide Manufacturers and Technical Assistance

Picloram, David England	509-697-5033
DowElanco	517-636-4400
Glyphosate (Rodeo), Mary Gilmore-Jones	206-775-3499
Monsanto	314-694-4000
CHEMTREC (technical assistance during emergency)	800-424-9300
Pesticide Safety Team of the National Agricultural Chemicals Association	513-961-4300
National Animal Poison Control Center	217-333-3611

Sources of Equipment and Operators for Spill Cleanup:

Spill kit, personnel at project, communications and hand tools shall be sufficient to control possible spills.

The applicator will have an inventory of all pesticides currently in possession during application on National Forest System land, including manufacturer name and address, product name, chemical name, EPA registration number, and the Material Safety Data Sheet (MSDS). Applicator will insure that all pesticide containers are labeled with the correct identity of the pesticide, appropriate hazard warnings, and the name, address and emergency notification phone numbers of the chemical manufacturer, importer, or responsible parties.

Contractors, if used, will notify appropriate State and Federal agencies of spill and disposal plans. Contractor will be responsible for cleanup of all spills and disposal of contaminated soil, water, equipment, cleanup materials or other contaminated products at an approved disposal facility.

Appendix C

Washington State Noxious Weed Category Definitions

The Washington State Noxious Weed Board determines which plants will be designated as noxious weeds and where control will be required. The board classifies weeds based on the stage of invasion of each species. The classification system is designed: 1) to prevent small infestations from becoming large infestations, 2) to contain already established infestations to regions where they occur and prevent movement to un-infested areas, and 3) to allow flexibility at the local level to include widespread weeds for landowner management programs. Three classes of weeds are identified (A, B, and C), as well as a monitor list.

Class A weeds are non-native species with limited distribution in the state. Therefore eradication of all Class A weeds is required by state law.

Class B weeds are species that are established in some parts of the state, but have limited distribution or are not present elsewhere. In regions where a Class B is unrecorded or of limited distribution, prevention of seed production is required. In these areas the weed is a class B designate; it is designated for control by state law. In regions where a Class B is already abundant or widespread control is a local option. In these areas the weed is a "class B designate" with containment, gradual reduction, and prevention of further spread as the chief goals.

Class C weeds are already widely established in the state, or are of special interest to the agricultural industry. Placement of the state noxious list allows counties to enforce control locally if desired.

The board also maintains a monitor list of non-native species. Reasons for inclusion on the monitor list include information indicating that the species poses a potential threat, a need for additional information on distribution, abundance, or biology, a need to monitor for reoccurrence, a need to verify the existence of the species in the state, or presence in an adjacent state or province. Information collected on monitor species may be used to justify future inclusion on the state noxious weed list.

Appendix D

The following Threatened, Endangered, or Sensitive (TES) plants are known to occur, or have the potential to occur, on the Chelan Ranger District.

Species	Category	Habitat	Potential habitat present in project area?	Documented in project area?
<i>Agoseris elata</i>	RF-S	Meadows, open woods, exposed, rocky ridge tops on various slope aspects, from low elevations to treeline.	Yes	No
<i>Anemone nuttalliana</i>	RF-S	Alpine slopes with well-drained soils, 5,000 to 6,000 feet.	No	No
<i>Antennaria parvifolia</i>	RF-S	Dry, open places, openings in Ponderosa pine forests, on sand and gravel substrates, often on the riparian foothills of the Columbia Basin.	Yes	No
<i>Astragalus arrectus</i>	RF-S	Grassy hillsides, sagebrush flats, riverbluffs, to open pine forests.	Yes	No
<i>Botrychium lanceolatum</i> <i>Botrychium manganese</i> <i>Botrychium montanum</i>	RF-S	Old growth western red cedar, moist sites, mossy slopes, ridges, and benches.	No	No
<i>Botrychium lineare</i>	Proposed	Grassy slopes, streamside edges, and forest stands.	Yes	No
<i>Botrychium lunaria</i>	RF-S	Deep, shaded forests at low to mid elevations.	No	No
<i>Botrychium pinnatum</i>	RF-S	Moist deciduous and coniferous forests, and dry alpine ridgetops	No	No

Species	Category	Habitat	Potential habitat present in project area?	Documented in project area?
<i>Botrychium simplex</i>	RF-S	Mid-elevation meadows.	No	No
<i>Botrychium lunaria</i>	RF-S	Subalpine meadows	No	No
<i>Botrychium lanceolatum</i>				
<i>Carex comosa</i>	RF-S	Lake margins, drainage ditches, rivulets, wet meadows, and other wet places.	Yes	No
<i>Carex hystericina</i>	RF-S	Wet depressions, creek drainages, hillside seeps. 500-2600 feet elevation.	Yes	No
<i>Carex macrochaeta</i>	RF-S	Seepage areas, around waterfalls, and other wet, open places, 600 to 3200 feet.	Yes	No
<i>Carex pauciflora</i>	RF-S	Fens and bogs from low to mid elevations throughout region. Sphagnum bogs, wet meadows.	No	No
<i>Carex proposita</i>	RF-S	Open rocky slopes and ridges, often on talus, at high elevations in the mountains, near or above treeline.	No	No
<i>Carex saxatalis</i> var. <i>major</i>	RF-S	Shallow, ponded water about 10 cm deep, with a rocky, silty subsoil. Bogs and sedge-dominated wetlands, mid-elevation to above treeline.	No	No
<i>Carex stylosa</i>	RF-S	Saturated and seasonally flooded fiberous and sphagnum peat soils, or sloping wetlands with surface seepage.	No	No
<i>Carex sychnocephala</i>	RF-S	Marshes, beaches, lake margins, and other low, wet ground.	Yes	No
<i>Castilleja cryptantha</i>	SC	Grass-dominated subalpine meadows, generally on level ground with well-developed soils.	No	No
<i>Chaenactis thompsonii</i>	RF-S	Serpentine, dry, rocky slopes and ridges. 1600 to 2400 feet.	No	No
<i>Cicuta bulbifera</i>	RF-S	Marshes, bogs, wet meadows, other wet areas from plains and lowlands to mountain valleys.	Yes	No
<i>Coptis aspeniifolia</i>	RF-S	Cool, moist, old-growth forest habitats. Restricted to western North Cascades and western Olympics.	No	No

Species	Category	Habitat	Potential habitat present in project area?	Documented in project area?
<i>Cryptogramma stelleri</i>	RF-S	Moist, shaded cliffs, ledges, and rocky slopes at mid and upper elevations in mountains	Yes	No
<i>Cypripedium fasciculatum</i>	SC	Low to upper elevations, in moist to dry, rocky, open coniferous forests. Often with ponderosa pine and Douglas fir.	Yes	No
<i>Cypripedium parviflorum</i>	RF-S	Bogs, damp, mossy woods, seeps, moist meadows.	Yes	No
<i>Delphinium viridescens</i>	SC	Moist microsites in open coniferous forests, 1800 to 4200 feet.	Yes	No
<i>Eleocharis atropurpea</i>	RF-S	In wet places, along lakeshores.	Yes	No
<i>Erigeron salishii</i>	RF-S	Alpine fellfield, on upper slopes.	No	No
<i>Galium kamtschaticum</i>	RF-S	1500 to 3500 feet. On low angle slopes with saturated soils under dense shrub thickets, in old-growth canopy gaps. Moist, cold coniferous forests and mossy places.	No	no
<i>Geum rossii</i> var. <i>depressum</i>	RF-S	Rocky bluffs, rock crevices, talus slopes, and serpentine up to 8500 feet.	Yes	No
<i>Hackelia hispida</i> var. <i>disjuncta</i>	RF-S	Rocky, often unstable talus slopes, usually with little other vegetation, 600 to 1500 feet.	Yes	No
<i>Hackelia taylorii</i>	RF-S	Alpine	No	No
<i>Hackelia venusta</i>	SC, Proposed E	Rocky, loose, sandy slopes with ponderosa pine, 1000 and 7000 feet.	Yes	No
<i>Howellia aquatilis</i>	T, WA T	In eastern WA, in forested portions of channeled scablands. In small, vernal ponds. 10 – 2300 feet. Requires seasonal inundation.	No	No
<i>Iliamna longisepala</i>	RF-S	Dry sagebrush steppes, and open hillsides, gravelly streamsides, open ponderosa pine and Douglas fir forests, 650 to 4000 feet.	Yes	No
<i>Loiseleuria procumbens</i>	RF-S	Alpine slopes, moist meadows near lakes in the subalpine zone.	No	No

Species	Category	Habitat	Potential habitat present in project area?	Documented in project area?
<i>Mimulus suksdorffii</i>	RF-S	Dry, rocky, shallow soil in sagebrush or ponderosa pine. In association with grasses, <i>Phlox</i> , <i>Allium</i> , and <i>Erigeron</i> . Also in wetter areas, 3500 to 4000 feet.	Yes	No
<i>Montia diffusa</i>	RF-S	Moist woods, at lower elevations	No	No
<i>Nicotiana attenuata</i>	RF-S	Dry, sandy places often with sagebrush.	Yes	No
<i>Pedicularis rainierensis</i>	RF-S	Moist alpine and subalpine meadows, and coniferous forests. 4000 to 7000 feet	No	No
<i>Pellaea brachyptera</i>	RF-S	Dry, rocky slopes with bluebunch wheatgrass and <i>Aspidotis densa</i> , talus slopes, crevices, outcrops, sometimes in scattered ponderosa pine and Douglas fir forests.	Yes	Yes
<i>Pellaea breweri</i>	RF-S	Rock crevices, ledges, and talus slopes, less often in open rocky soil from the foothills to about timberline in the mountains. Mostly at about 7500 feet elevation. In WA collected from near treeline and on serpentine soils.	No	No
<i>Petrophytum cinerascens</i>	SC	Crevices of gneissic cliffs along the Columbia River.	No	No
<i>Phacelia minutissima</i>	SC	Moist, open places, 4600 to 8600 ft elevation. Edge of meadow, near alder, in dry rocky soil.	No	No
<i>Physaria didymocarpa</i> var. <i>didymocarpa</i>	RF-S	River gravel bars, shale outcrops, rocky flats, gravelly prairies, talus slopes, dry hillsides, and road cuts (very well-drained soils with little vegetation cover).	Yes	No
<i>Platanthera chorisiana</i>	RF-S	Tundra-like hillsides of grasses and mossy turf, damp meadows.	No	No
<i>Platanthera obtusata</i>	RF-S	Damper wet places in forests, marshes, bogs, and along streambanks. In WA, with PIEN and THPL, 800-5000 feet.	No	No
<i>Platanthera sparsifolia</i>	RF-S	Open wet areas, seeps, and bogs at low to mid elevations, western hemlock zone.	No	No

Species	Category	Habitat	Potential habitat present in project area?	Documented in project area?
<i>Salix vestita</i> var. <i>erecta</i>	RF-S	Open, high altitude areas, often where there are springs, commonly near or above treeline.	No	No
<i>Saxifragopsis fragarioides</i>	RF-S	Cracks and crevices on cliffs, and in rock outcrops and talus. Near PIPO/PSME forests. Elevation 1400-4300 ft in WA.	Yes	No
<i>Sidalcea oregana</i> var. <i>calva</i>	PE	Dry forest and moist meadows, stream margins generally within ponderosa pine forests. With quaking aspen and Wenatchee larkspur in moist sites.	Yes	No
<i>Silene seelyi</i>	SC	Basalt and granite crevices on rock outcrops on vertical cliffs, usually in the absence of other species, 2000 to 7000 feet.	Yes	No
<i>Silene spaldingii</i>	SC, WA T	Open grasslands with a minor shrub component and occasionally scattered conifers. With Idaho fescue and snowberry.	Yes	No
<i>Spiranthes diluvialis</i>	T	Seasonally flooded moist meadows, near PIPO woodlands and sagebrush steppe	Yes	No
<i>Spiranthes porrifolia</i>	RF-S	Dry to moist meadows, swampy areas, sea-level to moderate elevations in mountains	Yes	Yes
<i>Trifolium thompsonii</i>	SC	Open to lightly wooded habitat in the big sage/Sandburg's bluegrass association.	Yes	No

R-F – S = Regional Forester Sensitive Species

T = Species listed as threatened by the U.S. Fish and Wildlife Service

WA-T = Species listed as threatened by Washington State

E = Species listed as endangered by the U.S. Fish and Wildlife Service

SC = Species of concern, U.S. Fish and Wildlife Service

Appendix E

Table 3-8. Rates of Accelerated Soil Erosion

		Soil Erosion Crupina Control Project (tons/year)			
Alternative		Watersheds			
		Fish Creek	North Shore	Prince Creek	Canoe Creek
Background (BG)		9480	9570	13790	1580
Alternative A		9490	*9800	13800	1580
% Change from BG		0	*2	0	0
Alternative B		9490	9990	13800	1580
% Change from BG		0	4	0	0
Alternative C		9490	10300	13800	1580
% Change from BG		0	8	0	0
Alternative D		9490	10000	13800	1580
% Change from BG		0	4	0	0

Accelerated soil erosion was estimated using the Universal Soil Loss Equation and coefficients as provided in Darrach *et. al.* (1978). The above shows estimates by alternative, by analysis watershed. This represents accelerated sediment movement off the treatment sites.

The estimates reflect short-term changes and the sediment production for the Alternatives B, C, and D would move back towards the background levels in a few years (3-years or less). In Alternative A, sedimentation would remain at a higher level which would account for the accelerated sediment production due to the weakly developed roots of crupina occupying the historical sites. For comparison purposes, these estimates reflect treatment (or non-treatment in Alternative A) of up to 640-acres in a single year, for manual, mechanical, and chemical treatment methods.

*For Alternative A only, if crupina were to spread to the maximum area of about 4,500-acres, instead of the 500-acres of historically infested area, sediment production would increase to about 11,210-tons/year which would be about a 17% increase over background sediment levels.

Appendix F

Excerpts from the 1964 Wilderness Act

Wilderness System Established Statement of Policy:

Section 2(a). In order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition, it is hereby declared to be the policy of the Congress to secure for the American people of present and future generations the benefits of an enduring resource of wilderness. For this purpose there is hereby established a National Wilderness Preservation System to be composed of federally owned areas designated by Congress as "wilderness areas", and these shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character" and for the gathering and dissemination of information regarding their use and enjoyment as wilderness;

Definition of Wilderness:

Section 2(c). A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in the Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which 1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; 2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; 3) has at least five thousand acres of land or is sufficient size as to make practicable its preservation and use in an unimpaired condition; and 4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Special Provisions

Section 4(d). In addition, such measures may be taken as may be necessary in the control of fire, insects, and diseases, subject to such conditions as the Secretary deems desirable.

Appendix G

Wilderness Recreation Opportunity Spectrum (WROS) Class Descriptions

SEMI -PRIMITIVE

The area is characterized by a predominantly unmodified environment of at least moderate size. System trails and campsites are present and there is evidence of other uses. A minimum of on-site controls and restrictions are implemented to protect physical, biological, and social resources. Some facilities may be present to reduce visitor impact.

This class extends at least 500-feet on both side of trail corridors, but may be wider around lakes, in drainage basins, and heavily used areas where the sights and sounds of people are noticed at greater distances.

A moderate to high degree of opportunity exists in this class for exploring and experiencing isolation from the sights and sounds of civilization. The environment offers a moderate to high degree of challenge and risk.

TRANSITION

The area is characterized by a predominantly unmodified environment however the concentration of visitors may be moderate to high at various times. The area is characterized as having a large number of day users who are often mixed with overnight and long-distance travelers on trails near trailheads and wilderness boundaries.

The transition area is generally small and extends into wilderness a short distance to where side trails begin to distribute use. The class extends at least 500-feet on both sides of a trail and may be wider around lakes or heavily used areas.

Opportunities for exploration and experiencing isolation are reduced and visitors can expect to encounter the greatest number of people compared to other WROS classes. This class introduces users to the wilderness setting, but the higher standard trails offer reduced challenge and risk.

APPENDIX H

Table 3-4. Wildlife Management Indicator Species

SPECIES	VIAB. (A)	Habitat Capability (B)	FOREST TYPE/STAGE		UNIQUE HABITATS		CONSERVATION MEASURES	
			DRY	WET	Meadow/Shrubs	Talus/Screes	Cliff/Caves	Riparian/Wetland
RUFFED GROUSE			BF	BF				BF
PILEATED WOODPECKER	4			BF				
BEAVER (Wen NF Only)		X	X	X			X	X
MULE DEER			BF	BF	F		X	
MOUNTAIN GOAT (Wen NF Only)		No Change in HC						
LEWIS'S WOODPECKER	4		BF	BF				
RED-BREASTED SAPSUCKER	3		X	X				
WILLIAMSON'S SAPSUCKER	3				X	X		
DOWNTY WOODPECKER	3				BF	BF		
Hairy Woodpecker	2				BF			
WHITE-HEADED WOODPE	4				X			
NORTHERN FLICKER			BF	BF	BF			F
(A) Viability	1= Habitat is broadly distributed with little or no limits to population interactions.							
	2= Habitat is broadly distributed but some gaps exist. Disjunct patches generally allow species to interact as a metapopulation.							
	3= Habitat exists primarily as patches; some populations are isolated.							
	4= Habitat exists as isolated patches with limited opportunity for population interactions. Local populations may be extirpated.							
	5= Habitat is very scarce with little or no possibility for interactions of populations. Strong potential for extirpations.							
(B) Habitat Capability (HC)	These are based on Lehmkuhl et al. 1997. Historical and Current Status of Terrestrial Species and the Effects of Proposed Alternatives. USDA Forest Service. PNW-GTR-409.							
	(B) Habitat Capability (HC) This column shows the trends in habitat capability based on Lehmkuhl et al. 2001. Effects of Ecosystem management alternatives on elk, mule deer and white-tailed deer.							
	Forest Ecology and Management 153:89-104 and Wisdom et al. 2000.							
	Source habitats for terrestrial vertebrates USDA Forest Service, PNW-GTR-485							
B = Habitat used by this species for breeding								
F = Habitat used by this species for foraging								
X = Habitat used by this species but no specific behavior was documented.								

APPENDIX I

MEDIATED AGREEMENT CONSISTENCY

Pages 14-17 of the 1989 Mediated Agreement list site-specific analysis considerations for vegetation control projects. These are all analyzed and included in the FEIS and supporting documents. The follow table lists where the analysis is located for each item.

Analysis Consideration	Location in FEIS
1.2.(1-5) Consider and analyze the strategy of prevention	FEIS, Chapter 1, Purpose and Need, pages 1-11 to 1-12 FEIS, Chapter 2, Weed Prevention Strategy, page 2-5 FEIS, Chapter 2, Comparison of Alternatives, pages 2-17 to 2-18 FEIS, Chapter 3, Competing and Unwanted Vegetation, pages 3-1 to 3-7
1.b Consider prevention at earliest reasonable time.	FEIS, Chapter 1, Purpose and Need, pages 1-11 to 1-12 FEIS, Chapter 2, Weed Prevention Strategy, page 2-5
1.c. Early treatment methods should be considered.	FEIS, Chapter 2, Alternatives Considered in Detail, pages 2-1 to 2-4
1.d. Site specific analysis to take place as part of NEPA process.	FEIS, and analysis file
2.a.(1) Analyze management goals.	FEIS, Chapter 1, Current Law, Management Direction, and Guidance, pages 1-5 to 1-11 FEIS, Chapter 1, Purpose and Need, pages 1-11 to 1-12 FEIS, Chapter 3, Competing and Unwanted Vegetation, pages 3-1 to 3-7
2.a.(2) Analyze required mitigation.	FEIS, Chapter 2, Features Common to All Alternatives, pages 2-5 to 2-7 FEIS, Chapter 2, Mitigation Measures, pages 2-7 to 2-13 FEIS, Chapter 2, Comparison of Alternatives, pages 2-17 to 2-18 FEIS, Chapter 3, Environmental Consequences
2.a.(3) Analyze risk of adverse human health effects.	FEIS, Chapter 2, Comparison of Alternatives, pages 2-17 to 2-18 FEIS, Chapter 3, Human Health Effects, pages 3-86 to 3-100
2.a.(4) Analyze risk of environmental damage.	FEIS, Chapter 2, Comparison of Alternatives, pages 2-17 to 2-18 FEIS, Chapter 3, Environmental Consequences
2.a.(5) Analyze project feasibility.	FEIS, Chapter 3, Competing and Unwanted Vegetation, pages 3-1 to 3-7 FEIS, Chapter 3, Economics, pages 3-123 to 3-124
2.a.(6) Analyze potential of preventive strategies post project.	FEIS, Chapter 2, Alternative Descriptions, pages 2-1 to 2-4 FEIS, Chapter 2, Weed Prevention Strategy, page 2-5 FEIS, Chapter 3, Competing and Unwanted Vegetation, pages 3-1 to 3-7
2.b Potential Environmental Effects.	FEIS, Chapter 2, Comparison of Alternatives, pages 2-17 to 2-18 FEIS, Chapter 3, Environmental Consequences
2.c.(1) Physical and biological characteristics of the sites.	FEIS, Chapter 3, Affected Environments

Analysis Consideration	Location in FEIS
2.c.(2) Relationship between associated vegetation and management goals.	FEIS, Chapter 1, Current Law, Management Direction, and Guidance, pages 1-5 to 1-11 FEIS, Chapter 1, Purpose and Need, pages 1-12 to 1-13 FEIS, Chapter 3, Competing and Unwanted Vegetation, pages 3-1 to 3-7 FEIS, Chapter 3, Native Vegetation, pages 3-7 to 3-11 FEIS, Chapter 3, Sensitive Plants, pages 3-11 to 3-19 FEIS, Chapter 3, Survey and Manage, pages 3-19 to 3-20
2.c.(3) Least amount of acreage needing treatment.	FEIS, Chapter 1, Purpose and Need, pages 1-11 to 1-12 FEIS, Chapter 2, Alternatives Considered and Analyzed in Detail, pages 2-1 to 2-4 FEIS, Chapter 2, Features Common to All Alternatives, pages 2-5 to 2-7 FEIS, Chapter 2, Mitigation Measures, pages 2-7 to 2-13 FEIS, Chapter 2, Monitoring Requirements pages 2-14 to 2-15
2.c.(4) Consider efficacy of proposal.	FEIS, Chapter 2, Comparison of Alternatives, pages 2-17 to 2-18 FEIS, Chapter 3, Competing and Unwanted Vegetation, pages 3-1 to 3-7 FEIS, Chapter 3, Economics, pages 3-123 to 3-124
2.c.(5) Evaluate costs.	FEIS, Chapter 3, Economics, pages 3-123 to 3-124
2.c.(6) Evaluate risks to environment.	FEIS, Chapter 2, Comparison of Alternatives, pages 2-17 to 2-18 FEIS, Chapter 3, Environmental Consequences
2.c.(7) Predict expected results.	FEIS, Chapter 3, Competing and Unwanted Vegetation Effects, pages 3-1 to 3-7
2.c.(8) Describe information to be tracked.	FEIS, Chapter 2, Monitoring Plan, page 2-15

Appendix J

Agency Response Letters

Letters from the U.S. Department of Interior and the Environmental Protection Agency in response to the DEIS for the Crupina Integrated Weed Management Project are on pages J-3 through J-7.

U.S. Department of Interior Comment Letter

No substantive comments.

Environmental Protection Agency Comment Letter

1. Include a definition of suitable habitat for crupina.

The characteristics of suitable habitat is described on page 1-14 of the FEIS, and Table 1-2. Crupina could be expected to spread into any area with suitable habitat characteristics regardless of wildfire activity. Crupina life history and vectors of spread are disclosed on page 3-2 of the DEIS (FEIS, pages 1-14 to 1-15 and page 3-2).

2. Describe the natural and disturbed conditions which may be hospitable or favorably promote the establishment of usable habitat for this noxious weed species.

As stated on page 3-2 of the DEIS, crupina grows primarily in grassland habitat (FEIS, page 3-2). Page 3-3 of the DEIS discloses that crupina infestations expanded into areas previously dominated by trees before the Rex Creek wildfire, and individual crupina plants increased in vigor, both in size and seed output. The increased sunlight reaching the ground after the fire provided a favorable environment for crupina (FEIS, page 3-3).

3. Discuss whether Lake Chelan as a vector for spread of crupina.

The literature indicates that streams and rivers can distribute common crupina seed but is silent regarding lakes. Although it is possible some seed does reach the shore of Lake Chelan, there is no indication that crupina seed has been spread by the lake to other areas. The rocky shoreline along Lake Chelan would likely prevent establishment (FEIS, page 1-15)

4. Provide a better map showing the wilderness boundary and Rex Creek wildfire area.

A map showing the full extent of the Lake Chelan-Sawtooth Wilderness Area and the Rex Creek wildfire area is in the FEIS, Figure 1-2, page 1-3.

5. Include scales on all maps to aid the reviewer in determining distance.

Scales were added to maps in the FEIS.

Comment Letter #2

Darrel —
Bob Sheehan —



United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
500 NE Multnomah Street, Suite 356
Portland, Oregon 97232-2036

IN REPLY REFER TO:

October 14, 2003

ER 03/738

Darrel Kenops
Acting Forest Supervisor
c/o Chelan District Ranger
428 West Woodin Avenue
Chelan, Washington 98816

Dear Mr. Kenops:

The Department of the Interior has reviewed the Draft Environmental Impact Statement for the Crupina Integrated Weed Management Project, Okanogan and Wenatchee National Forests, Chelan County, Washington. The Department does not have any comments to offer.

We appreciate the opportunity to comment.

Sincerely,

A handwritten signature in black ink, appearing to read "Preston A. Sleeger".

Preston A. Sleeger
Regional Environmental Officer



Comment Letter
#3

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

OCT 30 2003

Reply To
Attn Of: ECO-088

Ref: 02-075-AFS

Bob Cheehan, District Ranger
Okanogan and Wenatchee National Forest
Chelan Ranger District
2455 Highway 141
Trout Lake, WA 99650

Dear Ms. Henchell:

The U.S. Environmental Protection Agency (EPA) has reviewed the Draft Environmental Impact Statement (DEIS) for the proposed Crupina Integrated Weed Management Project pursuant to our responsibilities under Section 309 of the Clean Air Act and the National Environmental Policy Act (NEPA) as amended. Section 309, independent of NEPA, directs EPA to review and comment in writing on the environmental impacts associated with all major federal actions. The proposed planning area covers approximately 10,000 acres within the Okanogan and Wenatchee National Forest of north central Washington.

The proposed project seeks the control and eventual eradication of common crupina (*Crupina vulgaris* var. *brachypappa*) in Washington State. Current extent of infestation is limited to the Okanogan and Wenatchee National Forest and then only along a portion of the northern shores of Lake Chelan. Crupina is classified as a Class A noxious weed in Washington. This classification requires action by the landowner, here the U.S. Forest Service, to prevent further infestations.

The DEIS presents four alternatives. Alternative B proposes using only hand-pulling techniques for crupina management. Alternative C is the Proposed Action Alternative with an integrated emphasis using manual, chemical, and physical weed management practices. Alternative D proposes manual, chemical, and physical practices, with specific direction not to use mechanized support in Chelan-Sawtooth Wilderness Area. For baseline purposes, the DEIS proposed the No Action Alternative (Alternative A) which retains the current management approach.

Due to the spread of crupina infestations, EPA supports the Proposed Alternative, Alternative C, but can not support Alternative A (No Action) since this Alternative would not take action to

Alternative	Description	EPA's Rating and Explanation
Alternative A	No Action	EO - 3; not compliant with Executive Order 13112 and the Wilderness Act (1964)
Alternative B	Only Hand-Pulling Used	EC - 2; insufficient control of crupina in project area
Alternative C	Proposed Action Using Hand-Pulling, Herbicides, and Radiant Heat Disks	EC - 1; see attached detailed comments
Alternative D	Hand-Pulling, Herbicides, and Radiant Heat Disks - No Motorized Equipment or Mechanical Transport in Wilderness	EC - 2; insufficient control of crupina infestations in wilderness area

control crupina infestation in the project area. Please note our ratings for all Alternatives are presented in the table above. Since a Preferred Alternative was not developed for the DEIS, a Preferred Alternative must be developed for the Final Environmental Impact Statement.

In general, we support the intent and direction of an integrated pest management program for weeds as a multi-modal approach for the control and eradicate of invasive non-native plants. Furthermore, a sound integrated weed management program would adequately comply with the federal Executive Order 13112 on controlling invasive species. We are glad to see that the EIS will actively address how recreationists, who frequent the area either on foot or on horseback, can be considered as part of the solution to control infestations. Finally, we commend the Forest Service on its Proposed Alternative (Alternative C) to ensure the enduring resource values of wilderness in the Chelan-Sawtooth Wilderness Area.

While the DEIS has adequately set forth the environmental impacts, we suggest that additional information be included in the Final EIS for clarification. Please review our attached comments to aid in supplying the recommended additions. Based upon proposed Alternatives, we prefer Alternative C, the Proposed Alternative. These ratings for each Alternative and a summary of our comments will be published in the *Federal Register*.

I encourage you to contact Tom Connor at (206) 553-4423 if you would like to discuss our comments and how they might best be addressed. Thank you for the opportunity to review this DEIS on the Crupina Integrated Weed Management Project in Washington State.

Sincerely,


for Judith Leckrone Lee, Manager
Geographic Unit

Enclosures

3-5

**DETAILED COMMENTS ON THE CRUPINA INTEGRATED WEED MANAGEMENT PROJECT
DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)**

Definition of Suitable Habitat for *Crupina vulgaris*

We recommend that the Final Environmental Impact Statement (FEIS) provide a definition of suitable habitat and cultural requirements for crupina. With the recognition that the Rex Creek Wildfire or prior livestock activities may have created amenable conditions for the spread of this noxious weed, we recommend that the FEIS provide a working definition of advantageous seeding and land conditions which favor crupina establishment. Also, we recommend that the FEIS describe what are the natural and disturbed conditions which may be hospitable or favorably promote the establishment of usable habitat for this noxious species. For example, how does a wildfire open up the land's receptivity to infestation? This information will be useful for development of long-term strategies and management direction, especially under future situations where additional wildfires may alter landscape conditions for invasive species colonization.

Lake Chelan as a Potential Vector for Spreading Crupina

We recommend that the FEIS discuss whether this invasive species could be transported along open waters via Lake Chelan to spread its infestation. Lake Chelan is a major aquatic natural feature in the project area. It delineates the whole southern border of this proposed weed management project, yet the DEIS does not discuss whether the lake could be contributing to the dispersal of crupina. Since many invasive species use water courses as a means of transportation, the FEIS should evaluate Lake Chelan's potential role in the current infestation problem.

Improve Cartographic Information

The figures in the DEIS do not adequately illustrate the extent or proximity of the Rex Creek Wildfire or the federally designated Chelan-Sawtooth Wilderness Area to the project area. Since both the wildfire and federally withdrawn areas are important for management direction and development of Alternatives, we strongly recommend that maps depicting this information be included in the FEIS. Also, we recommend that all figures contain a scale to aid the reviewer in determining distance and size of elements within or adjacent to the project area.

SUMMARY OF RATING DEFINITIONS AND FOLLOW-UP ACTION*

Environmental Impact of the Action

LO--Lack of Objections

The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC--Environmental Concerns

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

EO--Environmental Objections

The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU--Environmentally Unsatisfactory

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potentially unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEQ.

Adequacy of the Impact Statement

Category 1--Adequate

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2--Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

Category 3--Inadequate

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment.

Appendix K DEIS Comment Response

The response to public comments on the Crupina Integrated Weed Management Project DEIS follows:

1. Support Alternative B, hand-pulling.

Noted (non-substantive)

2. It is doubtful that herbicide application included in Alternatives C and D will increase productivity of this project enough to warrant the additional hazards.

The EIS shows that up to 100 more acres per year would be treated in Alternative C than with hand-pulling alone in Alternative B (DEIS, page 2-4; FEIS, page 2-4). Adjustments may be made in treatment acres and methods depending on the efficacy of treatment (DEIS, page 2-12, #8; FEIS, page 2-12). Human health and safety associated with herbicide use are discussed on pages 3-86 to 3-100 and page 3-124 of the DEIS (FEIS, pages 3-86 to 3-100 and page 3-124).

3. Request to defer use of herbicides adjacent to the Swartz property, particularly near the water supply.

The FEIS includes a mitigation measure that no herbicides will be used within 100-feet of the Swartz property boundary, including the water source. (FEIS, page 2-10).

4. The DEIS contains little information on the effectiveness of radiant disk treatments. Due to the logistics with supplying fuel and the difficulty in handling equipment and fuel on steep slopes, this approach may not do much to increase productivity of the project.

Up to 100-acres of crupina treatment using a combination of hand-pulling and radiant heat disk methods would be done. Radiant disk treatments will only be used under limited circumstances where conditions favor effectiveness (DEIS, page 3-5; FEIS, page 3-5).

5. Hand-pulling too early results in multiple sprouts of crupina, each with a large seed-bearing plant.

As disclosed in the DEIS on page 3-2, crupina is a winter annual that germinates from seed (FEIS, page 3-2). No evidence is available in the scientific literature, nor have Forest Service personnel observed multiple sprouting of broken crupina plants. However, it has been observed that rodents cache seeds that result in the appearance of multiple sprouts.

6. The DEIS seems to disparage the effectiveness of hand-pulling alone. There hasn't been enough sustained treatment in wilderness to determine whether one method or another would be successful.

The preferred alternative uses all available effective tools, including hand-pulling. This is expected to be more effective than any one treatment alone (DEIS, page 1-10, and pages 3-3 to 3-7; FEIS, page 1-11, and pages 3-3 to 3-7). The scientific literature shows that limiting treatment of crupina to only one treatment method will likely fail (Sheley and Petroff, 1999). The DEIS discloses that under certain circumstances, hand-pulling alone is effective at containing crupina (DEIS, page 3-4; FEIS, page 3-4), but it is unlikely that crupina would ever be controlled. The use of herbicides would capture more of the delayed germinants, allowing a progression of containment, control, and eradication (FEIS, page 3-5).

7. The DEIS estimated five days of saturated soil conditions isn't realistic. The steep slopes and rapidly changing water table suggest that herbicides will migrate from the application area.

The DEIS also examines the potential for migration with 15-days of saturated soil conditions. Saturated soil conditions require that soil pore spaces be completely filled with water, a condition only occurring during periods of rapid snow melt and high intensity rain. It is unlikely that these conditions would exceed 15-days per year (DEIS, pages 3-80 to 3-81; FEIS, pages 3-80 to 3-81).

8. Given the highly variable weather conditions in the treatment area during spring, avoiding the use of picloram during wet periods would add a large degree of chance to treatments in a given season.

Weather considerations affect the ability to accomplish any of the treatments proposed for this project. Alternative C includes all effective methods of treatment of crupina to allow maximum flexibility due to varying conditions (FEIS, page 3-7).

9. Overabundance of grass creates a serious fire hazard. In some locations, grass obscures the Lakeshore Trail.

The Rex Creek Fire stimulated native and non-native grasses already on site; it is primarily cheatgrass that obscures the Lakeshore Trail (FEIS, page 3-3). Cheatgrass, a non-native annual weed, presents the greatest fire hazard because it grows abundantly and matures rapidly, drying out early in the year. As an annual, cheatgrass does not effectively exclude crupina. Cheatgrass was not seeded after the fire, nor will it be seeded after the planned crupina treatments.

10. Grasses do not crowd or discourage growth of crupina, but make it more difficult to find and treat. When we have hand-pulled, we found crupina growing in the middle of bunch grass growths.

Seeded grasses occupy growing spaces that would otherwise be occupied by crupina. Cheatgrass, like crupina, is a winter annual, and grows as individual plants, not clumps; it is not effective in competing with crupina. Forest Service personnel have observed that grasses reduce the vigor of crupina, and observed greater densities of crupina where there is no grass. Much of the grass in the project area is not seeded grass, but rather fire stimulated non-native cheat grass, and other native grasses, such as pine grass. The post-fire aerial seeding done after the Rex Creek fire in the area occupied by crupina was done to occupy as much growing space as possible. The hand seeding proposed will be much more site-specific and targeted at areas with little or no native vegetation (DEIS page 2-6; FEIS, page 2-6).

11. A forestry consultant told me that heavy grass seeding is likely to suppress new trees, which have the best chance of controlling crupina through shading.

Site-specific seeding won't be done in a manner that would exclude the establishment of trees.

12. Seeding is important for erosion control and seeding should be limited to hillside areas where erosion is a problem.

There is a risk of soil erosion in much of the project area (FEIS, page 3-64), though most of the proposed seeding will be targeted at areas with little or no native vegetation (DEIS page 2-6; FEIS, page 2-6).

13. Treatments should be shifted three to four weeks later in spring to maximize efficiency. Plants that haven't sprouted can't be picked, poisoned or scorched.

Crupina seed is viable for up to three years. Germination can occur throughout the summer when favorable conditions exist. Treatment is proposed at the earliest possible time in the spring to prevent seed production. Treatment will be suspended when flowers develop such that seeds may be present and could be spread during treatment activity (DEIS, pages 3-3 to 3-7; FEIS, page 3-3 to 3-7). The residual effects of picloram address the delayed germination of crupina (FEIS, page 3-5).

Crupina seeds sprout at different times on different sites. Crupina sprouts earliest on the south-facing slopes near Prince Creek and later on more shaded sites closer to Moore Point. In 2002 Forest Service personnel started pulling in early April in the vicinity of Prince Creek. By the time pulling occurred at the sites around Moore Point (mid-May) some plants were already flowering. If the Forest Service waited later in the season to pull, the crews would need to be everywhere at once. By starting earlier, the amount of time spent pulling is extended. Crew time must be scheduled months in advance, so the pulling window must be estimated. Crupina treatments are scheduled to maximize the amount of crupina pulled at all high priority sites before the plants start to go to seed, given the crews and funding available (DEIS, pages 3-3 to 3-7; FEIS, pages 3-3 to 3-7).

Because crupina is an annual that reproduces by seed, it is critical to pull the plant prior to seed production. After seed is produced the plant dries out and dies. Pulling crupina that has gone to seed greatly increases the chance of accidentally spreading seed to a new site; seeds can travel on the workers clothing or boots, or can drop off plants before disposal. Disposal of crupina plants with seeds is more difficult or remote sites.

Forest Service personnel have not observed a significant increase in time-efficiency of hand-pulling when crupina plants are larger. This is because in early spring, when crupina plants are small, much of the surrounding vegetation is also short. Later in the season when crupina plants are taller, other plants are also taller, still requiring pullers to carefully sift through surrounding vegetation. In addition, it takes more time to dispose of larger plants.

Forest Service personnel have observed that pulling itself is a type of disturbance that stimulates the germination of crupina seeds in the soil. It is expected that some crupina seeds will sprout in sites previously pulled, and germination may occur throughout the summer if favorable conditions exist. This will be a problem as long as crupina seeds are present in the soil. The residual from the herbicide is the only treatment that addresses delayed germination (FEIS, page 3-5).

14. Every treatment area needs to be reviewed each year to avoid re-infestation.

Follow-up treatment is planned until the crupina is no longer found in a particular area (DEIS, page 1-13; FEIS, page 1-16). Information gained from each year will be reviewed and used to refine future treatments (DEIS, page 2-11; FEIS, page 2-11).

15. Funding must be ensured throughout the life of the project so that progress made in early years aren't lost if funding isn't available.

Funding has been obligated for treatment this next spring. Forest Service personnel recognize this and agree with the comment. Future funding from Congress is beyond the control of the agency, and outside the scope of the EIS.

Index

INDEX

- 2, 4-D Chapter 3, pages 3-76, 3-77, 3-78, 3-92
- 303(d) list Chapter 3, pages 3-54, 3-75, 3-76, 3-77, 3-82, 3-83
- algae Chapter 3, pages 3-50, 3-58
- AGDRIFT model Chapter 3, pages 3-79, 3-80, 3-83, 3-84
- amphibian Chapter 3, pages 3-49, 3-55, 3-58
- aquatic Chapter 1, pages 1-7, 1-9, 1-19, 1-20,
Chapter 3, pages 3-21, 3-38, 3-45, 3-49, 3-50, 3-52,
3-53, 3-55, 3-56, 3-57, 3-58, 3-59, 3-60, 3-61, 3-62,
3-63, 3-68, 3-69, 3-75, 3-79, 3-81
- Aquatic Conservation
Strategy (ACS) Chapter 1, page 1-9,
Chapter 3, pages 3-52, 3-53, 3-62, 3-63
- Banvil® Chapter 3, pages 3-2, 3-77, 3-78
- cheatgrass Chapter 1, pages 1-12, 1-14, 1-16
Chapter 3, pages 3-1, 3-3, 3-5, 3-6, 3-7, 3-22,
3-28, 3-30, 3-31, 3-34, 3-41, 3-64, 3-120
- competing and
unwanted veg. Chapter 1, pages 1-11, 1-20,
Chapter 3, pages 3-1, 3-3, 3-7
- core habitat Chapter 3, pages 3-21, 3-33, 3-34
- cultural treatment Chapter 2, pages 2-6, 2-13, 2-14
Chapter 3, pages 3-9, 3-17, 3-23, 3-87, 3-98, 3-100,
3-111
- Daphnia* Chapter 3, page 3-59
- Darcy equation Chapter 3, pages 3-79, 3-80
- displacement Chapter 3, pages 3-23, 3-27, 3-28, 3-29, 3-30, 3-33,
3-34, 3-35, 3-46, 3-67, 3-70, 3-120
- dyes Chapter 3, pages 3-93, 3-113, 3-114, 3-117

INDEX-1

INDEX

endocrine system	Chapter 3, pages 3-93, 3-94, 3-95
exposure	Chapter 3, pages 3-31, 3-36, 3-51, 3-66, 3-69, 3-72, 3-86, 3-87, 3-88, 3-89, 3-90, 3-91, 3-92, 3-95, 3-96, 3-97, 3-98, 3-99
Fish Creek/fish/fishery	Chapter 1, pages 1-4, 1-7, 1-18, 1-20, Chapter 3, pages 3-8, 3-12, 3-13, 3-14, 3-15, 3-21, 3-24, 3-27, 3-37, 3-38, 3-39, 3-49, 3-52, 3-53, 3-54, 3-55, 3-57, 3-58, 3-59, 3-60, 3-63, 3-73, 3-77, 3-78, 3-79, 3-81, 3-82, 3-83, 3-84, 3-85, 3-100, 3-101, 3-119
geology	Chapter 3, page 3-54
hardwood leaf litter	Chapter 2, pages 2-12, Chapter 3, pages 3-43, 3-46, 3-47
HCB	Chapter 3, page 3-92
herbicide drift	Chapter 2, page 2-15, Chapter 3, pages 3-9, 3-16, 3-86, 3-87, 3-96
herbicide profile	Chapter 3, pages 3-87, 3-93
invertebrate	Chapter 3, pages 3-58, 3-59, 3-60, 3-63, 3-81
LD-50	Chapter 3, pages 3-89, 3-91
Lucerne Basin	Chapter 3, page 3-74
macroinvertebrate	Chapter 3, page 3-58
mechanical treatment	Chapter 2, pages 2-3, 2-4, 2-14, Chapter 3, pages 3-69, 3-72, 3-98
mycorrhizal fungi	Chapter 3, pages 3-65, 3-66, 3-67, 3-68, 3-71, 3-73

INDEX

- | | |
|-------------------------------|--|
| native vegetation | Chapter 1, pages 1-9, 1-12, 1-15, 1-16, 1-19, 1-20
Chapter 2, pages 2-3, 2-6, 2-13, 2-14, 2-15, 2-17,
Chapter 3, pages 3-5, 3-6, 3-7, 3-8, 3-9, 3-16, 3-17,
3-23, 3-24, 3-25, 3-26, 3-28, 3-30, 3-31, 3-35, 3-41,
3-51, 3-64, 3-65, 3-66, 3-76, 3-80, 3-102, 3-103,
3-104, 3-110, 3-111, 3-112, 3-113, 3-114, 3-115,
3-116, 3-124. |
| PPE (pers protect. equipment) | Chapter 2, pages 2-9, 2-11,
Chapter 3, pages 3-87, 3-95, 3-98 |
| recreation | Chapter 1, pages 1-2, 1-6, 1-16, 1-17,
Chapter 2, pages 2-5, 2-11,
Chapter 3, pages 3-4, 3-9, 3-16, 3-21, 3-24, 3-25,
3-26, 3-27, 3-37, 3-38, 3-39, 3-60, 3-66, 3-67, 3-71,
3-73, 3-75, 3-76, 3-77, 3-78, 3-79, 3-82, 3-83, 3-84,
3-85, 3-86, 3-100, 3-101, 3-102, 3-103, 3-104, 3-105,
3-106, 3-107, 3-108, 3-109, 3-110, 3-111, 3-113,
3-114, 3-115, 3-116, 3-124 |
| recovery territory | Chapter 3, page 3-37 |
| RfD | Chapter 2, page 2-17
Chapter 3, pages 3-88, 3-89, 3-90, 3-91 |
| riparian habitat | Chapter 1, page 1-6,
Chapter 3, pages 3-21, 3-41, 3-44, 3-54 |
| riparian reserves | Chapter 1, pages 1-6, 1-8,
Chapter 2, page 2-3,
Chapter 3, pages 3-53, 3-56, 3-57, 3-61, 3-62, 3-63,
3-76 |
| route of exposure | Chapter 3, page 3-90 |
| security habitat | Chapter 3, pages 3-27, 3-29, 3-32, 3-33 |
| seeding | Chapter 2, pages 2-3, 2-4, 2-5, 2-6, 2-12
Chapter 3, pages 3-5, 3-6, 3-9, 3-10, 3-11, 3-17, 3-23,
3-25, 3-28, 3-30, 3-31, 3-34, 3-35, 3-39, 3-41, 3-58,
3-60, 3-67, 3-70, 3-77, 3-80, 3-82, 3-83, 3-84, 3-87,
3-97, 3-109, 3-110, 3-111, 3-112, 3-114, 3-117,
3-123, 3-124 |

INDEX

- | | |
|------------------------------|---|
| sediment | Chapter 3, pages 3-50, 3-54, 3-56, 3-57, 3-58, 3-60, 3-61, 3-62, 3-67, 3-69, 3-71, 3-72, 3-75, 3-76, 3-77, 3-78, 3-82, 3-83, 3-84, 3-85 |
| sensitive plants | Chapter 1, pages 1-8, 1-13, 1-17, Chapter 2, pages 2-6, 2-12, 2-15, Chapter 3, pages 3-11, 3-12, 3-16, 3-17 |
| soil erosion | Chapter 3, pages 3-64, 3-65, 3-66, 3-67, 3-68, 3-69, 3-70, 3-71, 3-72, 3-76, 3-78, 3-79, 3-82, 3-84, 3-98 |
| surfactant | Chapter 3, pages 3-50, 3-58, 3-59, 3-60, 3-68, 3-81, 3-93 |
| toxicity | Chapter 1, page 1-15, Chapter 2, page 2-17, Chapter 3, pages 3-42, 3-58, 59, 3-68, 3-71, 3-89, 3-90, 3-91, 3-92, 3-93, 3-94, 3-96, 3-98 |
| trout | Chapter 3, pages 3-52, 3-54, 3-59, 3-63 |
| Universal Soil Loss Equation | Chapter 3, page 3-79 |
| Wapato Basin | Chapter 3, pages 3-74, 3-75 |
| wilderness | Chapter 1, pages 1-3, 1-4, 1-5, 1-7, 1-11, 1-12, 1-14, 1-15, 1-16, 1-17, 1-19, 1-20
Chapter 2, pages 2-1, 2-3, 2-4, 2-6, 2-13, 2-17, 2-18, Chapter 3, pages 3-5, 3-6, 3-9, 3-11, 3-12, 3-18, 3-19, 3-21, 3-27, 3-32, 3-36, 3-38, 3-39, 3-56, 3-60, 3-72, 3-83, 3-86, 3-99, 3-100, 3-101, 3-103, 3-104, 3-106, 3-107, 3-108, 3-109, 3-110, 3-111, 3-112, 3-113, 3-114, 3-115, 3-116, 3-117, 3-124 |
| winter range | Chapter 3, pages 3-21, 3-22, 3-26, 3-31, 3-32, 3-34, 3-36, 3-37, 3-38, 3-40 |
| WROS | Chapter 3, pages 3-110, 3-111, 3-116 |

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